



**VIRTUALNESS OF THE COST ESTIMATING COMMUNITY**

**THESIS**

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VIRTUALNESS OF THE COST ESTIMATING COMMUNITY

THESIS

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### **Abstract**

Publicized criticism of Air Force cost estimates assert the Air Force produces program cost estimates that drift towards mediocre guesses compared to the high fidelity instruments of time and cost intended. While many researchers have sought to identify the sources for cost and schedule growth, most researchers have failed to analyze the resource utilization of the cost community. This research explores how the cost community allocates its time. Furthermore, by examining how resources are spent, this research juxtaposes the desires of recent Congressional and Department of Defense policies against the current demands of the cost community. A thorough understanding of resource allocation requires research into the inherent virtualness of the community. Early virtualness predicated the notion of extremes, either virtual or not. However, recent literature expands virtualness into gradients and explains that all teams display some measure of virtualness. Unfortunately, scholars currently debate the basic definition of virtualness as being comprised of either three or four individual dimensions. This research uses an Internet-based questionnaire to ascertain a measure of virtualness. The findings of this research support a four-dimension measure of virtualness. This research uses structural equation modeling to validate and test for good reliability of the created 13-item measure for virtualness. This research finds that the creation and modification of cost estimates consumes the majority of resources, while the cost-estimating community spends few resources on the implementation or follow-up of estimates.

*I dedicate these pages to family and friends, and most importantly, to my two beautiful children. Without their support, I would never have completed this endeavor.*

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# **VIRTUALNESS OF THE COST ESTIMATING COMMUNITY**

## **I. Introduction**

### **Overview**

Department of Defense (DoD) acquisition programs tend to cost more and require longer development periods than initially estimated (Bolten, Leonard, Arena, Younossi, & Sollinger, 2008). Some argue that Air Force cost estimates drift towards mediocre guesses compared to the intended high fidelity instruments of time and cost. Many researchers have powered much deliberation and investigation seeking to identify the sources for cost and schedule growth. Differing opinions have surfaced claiming insufficient resources, requirements creep, or inadequate training as possible drivers of cost growth (Bolten et al., 2008). While many researchers have sought to identify the sources for cost and schedule growth, most have failed to analyze the resource utilization of the cost community. This research explores how the cost community allocates its time and resources. Furthermore, by examining how resources are spent, this research will juxtapose the desires of recent policy changes and the current demands within the cost community.

In addition to resource allocation, a complete understanding of the cost community relies on an understanding of its inherent virtualness environment. Virtualness refers to the composition of distance, reliance on technology, value provided by technology and synchronicity of interactions. These four primary dimensions contribute to the level of virtualness (Kirkman & Mathieu, 2005; Griffith, Sawyer, & Neale, 2003). Among many moderating aspects of team effectiveness,

virtualness correlates with many potentially detrimental factors (Griffith et al., 2003).

Recent disasters on the Gulf Coast highlight the potential effects of virtualness. Communication breakdowns, information technology failures, and misinterpretations are three major contributing factors identified as interfacing with the Hurricane Katrina relief efforts (Garnett & Kouzmin, 2007). More recently, the British Petroleum (BP) Deepwater Horizon explosion contained aspects of virtualness in multiple ways. The explosion and resulting oil leak involved teams of physically separated people heavily reliant on technology and operating the well at extreme depths in the ocean. A situation exhibiting the four dimensions of virtualness. The equipment needed for capping the well relied solely on technology as the depth prevented a human from physically touching the well. The maintenance needed on the well required a remote operator performing intricate procedures miles away. The controller relied on the information provided by technology, as well as the value of the information returned through the remote cameras. The equipment and actual capping process demanded synchronicity, for any uncontrolled delay between operator input and equipment action could create unintended consequences. The BP disaster presents an unwelcome opportunity to study the potentially detrimental consequences of virtualness. However, this paper is not a case study of virtualness as it relates to cataclysmic disasters.

Traditional research into virtualness viewed teams as traditional or completely virtual (Anderson, McEwan, Bal, & Carletta, 2007). As the academic

community accepted virtualness, researchers started applying levels of virtualness to team dynamics. Hypotheses stated that companies were seldom wholly traditional (non-virtual) or completely virtual. Most organizations maintained some level of virtualness. These hypotheses limited virtualness as a level of an organization or product. However, recent research into virtualness progresses towards gradients of virtualness not being limited to organizations or products. Virtualness not only varies within an organization, but also may vary at a team or even personal level.

Virtualness as a management concept is still in its infancy, with the bulk of published research occurring within the last 20 years. While the knowledge base of virtualness continues to expand, the debate as to the exact elements comprising virtualness have solidified around three dimensions, with a fourth dimension being argued by many (Kirkman & Mathieu, 2005). While these dimensions have gained acceptance as accurate indicators for the level of virtualness, the researchers has yet to develop a valid and reliable measurement for virtualness. This research aims to build an accurate measurement for understanding the degree of virtualness exhibited at an individual level. The measurement, while developed in an Air Force community, should apply generically to all organizations.

## **Purpose**

Developing a virtualness measure has greatly enhanced my research into the organization of the cost community. This research effort intends to establish a snapshot for the Air Force cost estimating community. Understanding the



virtualness inherent within organizations allows decision makers to adjust leadership style and policy to enhance effectiveness. The complexity and hierarchical nature of the Air Force forces a certain amount of virtualness, yet virtualness establishes threats to effectiveness. Research, however, indicates that strong transformational leadership can overcome many of the detrimental aspects of virtualness (Hertel, Geister, & Konradt, 2005). Understanding the potential effects of virtualness married with the given level of virtualness apparent within a team, arms leadership with the opportunity to guide resources towards critical needs.

In addition to establishing a measure for virtualness, this research aims at identifying asset utilization in the cost estimating community with respect to personnel. Recent policies aimed at controlling program costs stress the importance of accurate cost estimates. As a result, the Air Force cost community is transforming and adapting to the increased pressures and demands. While leadership has stressed the need for the revitalization of the acquisition community, little understanding exists about its implementation or acceptance at the organizational level. This research utilizes an Internet-based questionnaire presented to cost estimators in hopes of obtaining a more thorough appreciation of the allocation of time. In addition to time allocation, the questionnaire probes into experience levels, training, and professional certificates of the military and civilian cost estimators. This research presented a similar but more open-ended questionnaire to supervisors. The supervisory questionnaire identifies how the

team as a whole allocates its time. The questionnaire also explores recent personnel and office changes subsequent of policy implementation.

The questionnaire provides a current snapshot of the cost estimating community. This research compares the findings against a similar census conducted by the RAND Corporation in 2008 (Vernez & Massey, 2009). Chapters 4 and 5 discuss and highlight potentially enlightening comparisons between the studies. In addition to the comparison, I also discuss the questionnaire findings for resource allocation, training, and virtualness in Chapters 4 and 5.

## **Study Context**

The effort to establish a reliable measure of virtualness centers on an individual level survey of approximately 400 Air Force cost personnel. The Air Force primarily centralizes the cost community within three organizational areas. The Air Force Cost Analysis Agency, headquartered in Washington, D.C., occupies the focal point of all cost analysis policy and acts as an independent cost review for major defense acquisition programs (MDAPs). The remaining centers of cost analysis lie at the two major commands (MAJCOMs), Air Force Material Command (AFMC) and Air Force Space Command (AFSPC). These MAJCOMs function as the acquisition centers for MDAPs for the Air Force. The hierarchical structure of the military, combined with the geographic separation between the Air Force Cost Analysis Agency and MDAP acquisition hubs, creates an excellent opportunity to

gather the information necessary to both establish a measure and build a baseline understanding of virtualness.

## **Research Questions**

This thesis addresses the following research questions:

Primary Research Question: Is there a disparity between leadership's expectations and employee's activities, which affect the implementation of the Weapons Systems Acquisition Reform Act of 2009 and the Acquisition Improvement Plan?

Secondary Research Question 1: What is the current allocation of time within the cost estimating community supporting acquisition reforms?

Secondary Research Question 2: Does virtualness affect the Air Force cost estimating community's ability to sufficiently support acquisition reform?

## **Hypotheses**

This thesis addresses the following hypotheses in support of the previously mentioned research questions:

Hypothesis 1: Virtualness is negatively correlated to trust.

Hypothesis 2: Virtualness is negatively correlated with job satisfaction.

Hypothesis 3: Virtualness is negatively correlated with organizational commitment.

Hypothesis 4: Virtualness is negatively correlated with turnover intention.

Hypothesis 5: Trust is negatively correlated with turnover intention.

Hypothesis 6: Job satisfaction is negatively correlated with turnover intention.

Hypothesis 7: Organizational commitment is negatively correlated with turnover intention.

Hypothesis 8: Trust mediates the correlation between virtualness and turnover intention.

Hypothesis 9: Job satisfaction mediates the correlation between virtualness and turnover intention.

Hypothesis 10: Organizational commitment mediates the correlation between virtualness and turnover intention.

### **Organization of Thesis**

The primary purpose of this paper is to establish a baseline measurement of virtualness of the cost community within the United States Air Force. However, to develop understanding, I first discuss some of the issues currently facing the cost community. This discussion includes recent changes undertaken by leadership to curb the dramatic growth in cost as shown by MDAP reports. In Chapter 2, I discuss some of the published literature relating to the contents of this thesis. Chapter 3 includes the methodology used to gather and analyze the data. In Chapter 4, I report the findings of my research. Lastly, in Chapter 5, I discuss the findings and the ways leadership can utilize the results to benefit the cost community.

## **II. Literature Review**

### **Chapter Overview**

Chapter II highlights some acquisition reform initiatives primarily focusing on the Weapon System Acquisition Reform Act (WSARA) of 2009 and the Air Force Acquisition Improvement Plan. This chapter also reviews research into the effectiveness of acquisition reforms and studies into the Air Force acquisition cost workforce. While there is a great deal of research into the effectiveness of reform initiatives, dissention among the conclusions, as well as problems with data and definitions, weakens the impact of the research. This chapter discusses the current research into the acquisition community--the RAND study, among others--and discusses some of its weaknesses and limitations. Next, I present literature on virtualness and the way my research establishes a more complete knowledge of the community and add insight into more effectively implementing reform. Lastly, this chapter highlights current trends in management studies, which promote a greater understanding into the utilization of cost personnel. Understanding the information within this chapter promotes a greater understanding and logical flow for subsequent information and the conclusions presented within later chapters.

### **Acquisition Reform**

The Department of Defense suffers a long history of acquisition problems and errors. While some issues result from single individuals manipulating opportunities in selfish ways, as with the Darleen Druyun case, many problems surround major

acquisition programs as a whole. Two detrimental problems of acquisition, cost overruns and schedule delays. Both problems often result in the delivery of fewer weapon systems to the warfighter behind schedule and at an increased cost per item. Negative results in major system acquisitions draw Congressional interest. In order to counteract detrimental trends in MDAPs, acquisition reforms pass through Congress at an alarming rate, culminating most recently in the Weapon Systems Acquisition Reform Act (WSARA) of 2009: "The purpose of this law will be to limit cost overruns before they spiral out of control" (President Barak Obama at signing of WSARA Legislation). Signed into law on May 22, 2009, WSARA aims at lofty improvements in major defense acquisition programs for the entire DoD. The overarching policy creates new government positions among other aspects, seeking to reduce cost overruns. One of the many major changes requires MDAPs to undergo a thorough preliminary design review before Milestone B. The total ramifications from this single policy change are estimated at being numerous and drastic; however, much of the ripple effect is unknown.

A recent policy targeting the Air Force specifically is the Acquisition Improvement Plan (AIP). Signed May 4, 2009, by Chief of Staff General Norton A. Schwartz, the AIP aims at "recapturing acquisition excellence by rebuilding an Air Force acquisition culture (Office of the Assistant Secretary of the Air Force (Acquisition), 2009). The plan states that many challenges face AF acquisition and identifies specific actions to counteract negative trends. While the plan summarizes five critical areas for improvement, one specifically relates to the underlying

purpose of this thesis: “unclear and cumbersome internal Air Force organization for acquisition and Program Executive Officer (PEO) oversight” (Office of the Assistant Secretary of the Air Force (Acquisition), 2009). The previous statements drive at the core of this effort: to understand the current cost acquisition workforce in order to help decision makers effectively utilize limited resources.

The sheer number of acquisition reform initiatives highlights the dire condition of MDAPs. Table 1 includes some of the major reform efforts to include policy changes and implement special commissions striving at improving government acquisitions.

**Table 1: Acquisition Reform Initiatives**

<b>Acts</b>	<b>Commissions</b>
*Armed Services Procurement Act of 1947	*1949 Hoover Commission
*Federal Procurement Policy Act of 1948	*1955 Hoover Commission
*Federal Procurement Policy Act Amendment in 1978 established the Federal Acquisition	*1969 Fitzhugh Commission
*Goldwater-Nichols Department of Defense Reorganization Act of 1986	*1972 Commission on Government Procurement
*Government Performance and Results Act 1993	*1981 Carlucci Initiatives
*Federal Acquisition Streamlining Act of 1994	*1982 Grace Commission
	*1986 Packard Commission
	*1989 Defense Management Report

## **Why Reform**

Central to the effort behind the numerous reform initiatives lies acquisition systems cost growth and schedule delay. Major defense acquisitions systems costs grow at the alarming rate of over 45% at milestone B on average (Arena, Leonard, Murray, & Younossi, 2006). Superficially, the previous statement rings of logic and understanding; however, what is cost growth or schedule delay? Is the idea that a weapon system costs more than initially expected cost growth? How often does the

DoD purchase a weapon system initially designed instead of an improved iteration that costs more yet has greater capabilities? The statement regarding cost growth is synonymous with schedule delay. One academic definition of cost growth is “the ratio between the most recent selected acquisition report (SAR) estimate and the cost estimate baseline reported in a prior SAR issued at the time of a given milestone” (Younossi, Arena, Leonard, Roll, Jr., Jain, & Sollinger, 2007). In the past 30 years, cost growth associated specifically with the development phase of MDAPs largely remained constant (Younossi et al, 2007). A RAND study published in 2008 identifies program decisions as the primary source of cost growth (Bolten et al. 2008). Changing requirements, quantity, or other decision factors account for over two-thirds of all cost growth (Bolten et al., 2008). Often, blame for cost growth gets pushed towards the realm of cost estimators; however, as indicated, two-thirds of cost growth is outside the estimators’ control. Not completely devoid of blame, the cost estimating community accounts for approximately one-fourth of total cost growth (Bolten et al., 2008). Acquisition reform addresses the cost estimating personnel due to inaccurate cost estimates accounting for 10.1% increase in MDAP cost (Bolten et al., 2008). However, the majority of reports indicating cost growth derive data from SARs. Legally mandated and heavily utilized by decision makers for budgetary decisions, the SAR is not without problems (Hough, 1992). Table 2 highlights the most notable problems that surround utilizing the SAR for data purposes.



**Table 2: Notable Problems of SAR (Hough, 1992)**

Failure of some programs to use a consistent baseline cost estimate
Exclusion of some significant elements of cost
Exclusion of certain classes of major programs
Constantly changing preparation guidelines
Inconsistent interpretation of preparation guidelines across programs
Unknown and variable funding levels for program risk
Cost sharing in joint programs
Reporting of effects of cost changes rather than their root causes

The problems originating through the use of an SAR for data analysis increase the need for thorough understanding by decision makers. Careful analysis and compensation techniques mitigate some risks and errors; however, any conclusions drawn from SAR reports must include necessary caveats to warn readers (Hough, 1992). In summary, between the fundamental problems of defining true cost growth and the inherent errors contained in utilizing SARs to produce growth estimates, the cost community must cautiously approach all reforms with knowledge and understanding.

### **Effectiveness of Acquisition Reform**

The sheer number of different reforms screams of a lack of effectiveness. The goal of many reform initiatives is to strengthen the acquisition community, control costs, and reduce schedule delays. The magnitude and scope of the Department of Defense complicates the implementation of reforms (Cooper & Rumbaugh, 2009). As such, much research seeks to understand how effective the acquisition reforms are when finally implemented. A few problems arise when trying to measure both implementation and effectiveness.

Implementing Congressional, DoD, or AF level policy changes require numerous geographically separated personnel to adjust standard work practices. The number of personnel alone is not the greatest difficulty. Policy interpretation yields disparity between organizations and individuals. The most mundane of changes must be coordinated amongst multiple stakeholders, all of whom provide guidance as to the interpretation of the policy. Senior leadership seeks to alleviate the interpretation disparity through guidance memorandums, which also require interpretation. At no point is it possible to completely remove differences in interpretation (Radin, 1999). In addition to actual interpretation issues, omissions or contradictions amplify the difficulties inherent in policy guidance (Radin, 1999).

Barring interpretation issues, full implementation is not instantaneous (Reig, 2000). The lag between enactment and implementation is a topic of much academic research. Researchers seeking to measure the effectiveness of reforms vary the implementation lag depending on the analysis (Holbrook, 2003; Phillips, 2008; Cooper M. A., 2002; Drezner, Jarvaise, Hess, Hough, & Norton, 1993). One researcher went so far as to claim the actual implementation of Congressional reform relied on the signing of subsequent reform acts (Holbrook, 2003). This research used two 1990s acts as example, the reforms included in the Government Performance and Results Act (GPRA) of 1993 and the Federal Acquisition Streamlining Act (FASA) of 1994 (Holbrook, 2003). Argumentatively, the author states the FASA of 1994 implemented many of the goals of GPRA without actually creating many new policies. The primary rationale surrounding this measurement

delay includes aspects of inertia. Many of the policy changes within a reform act strengthen previously enacted reforms. This strengthening solidifies the need for true implementation, causing understanding and appreciation of the reform by the personnel covered within the reform act (Phillips, 2008).

Beyond the defining of full policy implementation, the agreement on actual effectiveness measures is central to determining the success of acquisition reforms. Previous empirical research utilized the SAR as source data (Holbrook, 2003). As previously discussed within this paper, the utilization of SAR data does not immediately preclude the legitimacy of resulting interpretations; however, the information must be thoroughly analyzed and interpreted. Beyond the utilization of questionable data sources, the interpretation of cost growth lessens the applicability of these reports (Hough, 1992). Drezner et al., (1993) and Christensen, Searle, & Vickery, (1999) all conducted empirical studies with results showing consistent annual cost growth within numerous major acquisition programs. The impossibility of measuring the cost growth of a weapon system had acquisition reforms not been implemented versus real world cost growth has not kept researchers from trying. Should acquisition reforms be considered ineffective if studies show no decrease in cost growth following policy implementation?

Multiple studies into the effectiveness of acquisition reforms utilize SAR data against a reform timeline to determine if any correlation exists. Research indicates that aircraft acquisitions from 1960 through 1990 averaged a 28% cost growth (Younossi et al., 2007). This differs from reported cost growth of 40% for programs

dating 1991 through 2001 (Phillips, 2008). Examining the pre and post reform cost growth percentages research indicates that there is no statistical difference in growth rate (Holbrook, 2003). A similar study conducted in 2004 by Phillips supports the finding of no statistical difference. One positive aspect of policy reform centers on contract management cost variance. Research indicates a positive correlation between contract cost variance and acquisition policy implementation (Holbrook, 2003). While a correlation adds credence to arguments supporting acquisition reform, it does not prove causality. Contrarily, the possibility remains that the increased awareness of problems decreases cost variance as much as the actual reform initiatives. Additionally, the repetition of reform themes, such as streamlining or leaning the process or Congressionally stipulated requirements, raises concern as to the underlying validity of new reform initiatives (Phillips, 2004).

One major issue with previously mentioned studies on the effectiveness of acquisition reform efforts centers upon the selection of the treatment date. In the study conducted by Phillips, the treatment date of December 31, 1996, differs from other research using a December 31, 1991, date as the delineation between pre and post reform implementation (Smirnoff, 2006). While instituting a single treatment date simplifies the analysis process, the results require further investigation and understanding as to true results. The reality of multiple reform initiatives after said treatment dates negates the certainty of the results. Accordingly, a study conducted

in 2006 contradicts much of the previous research into the effectiveness of acquisition reforms.

Rather than examining acquisition reform initiatives as a whole along a continuous timeline, Smirnoff (2006) examined each reform individually. Smirnoff identified the lack of variables included in previous research as a potential weakness in the research. The 2006 thesis utilized a fixed-effect model with cost overruns as the dependent variable and multiple independent variables. Smirnoff included the Packard Commission, Federal Acquisition Streamlining Act, Nunn-McCurdy Act, and the Defense Acquisition Workforce Improvement Act, among other non-reform variables, in the study. Surprisingly, Smirnoff found that “the Packard Commission and many other acquisition reforms would have reduced cost overruns had the other factors, such as decreasing defense budgets, not overwhelmed their impact” (Smirnoff, 2006). The results indicated that variability of numerous aspects of major defense acquisition programs complicate the ability to effectively identify exact results of reform initiatives.

Smirnoff, understanding that correlation is not synonymous with causality, identified areas for further research, seeking to identify more variables needed to create a stronger model. A question not yet researched surrounds the placebo effect identified in medical studies. Medical research takes great care to ensure participants in an experiment remain unaware of who is receiving actual medication versus those receiving a placebo. The reasoning behind this experiment control is the reality that humans act differently depending on what they perceive to be the

truth. Relating the placebo effect to reform initiatives, does the idea that the government is looking at reforming acquisition have as much an effect as the actual reform initiative? Could a placebo reform, which actually changes nothing, actually create an environment where cost variance improves?

### **The Cost-estimating workforce**

The research into acquisition reform effectiveness traditionally seeks to identify any statistical variance in cost growth pre/post implementation of the reform. Failing to identify specific areas of change included in the reform is an area of weakness in the previous studies. For example, the Packard Commission recommended among other items, changing the organizational culture within the acquisition community. Little research is available as to the cost growth implications of how changing the organizational culture helped reduce cost growth. The research naively treats all reform initiatives generically, no matter what the actual goals. This research aims at changing this norm and creating an understanding of what specific reactions the cost community implements to enact the goals of acquisition reform, specifically in reaction to the WSARA.

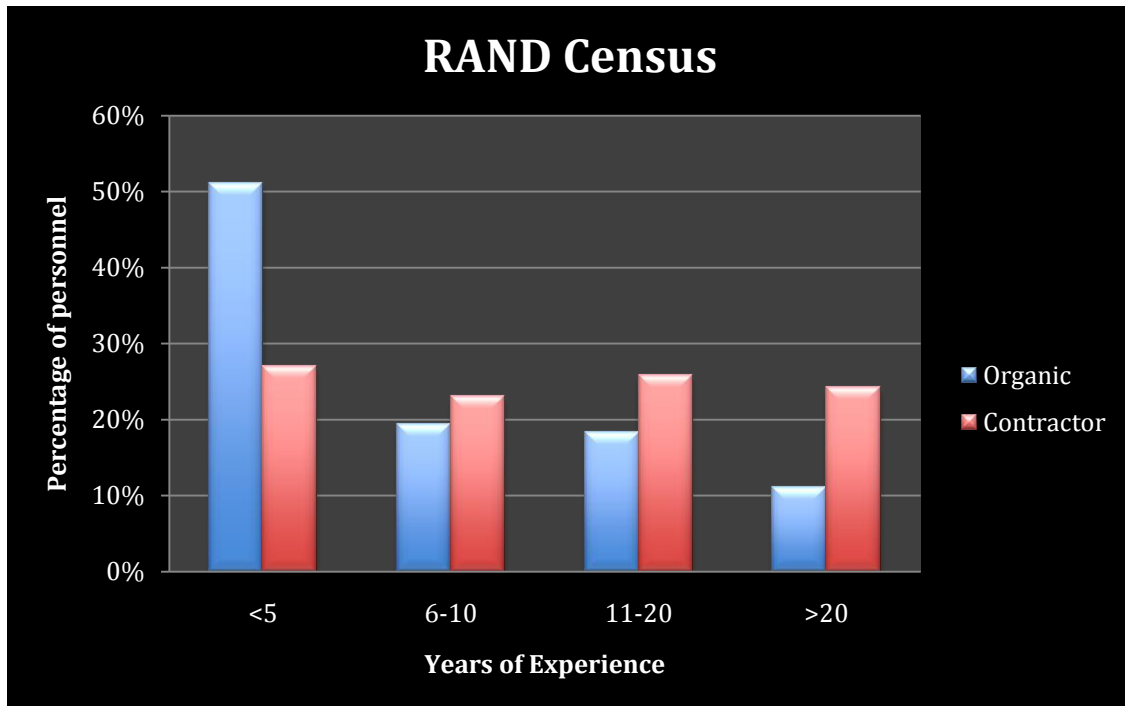
The John Warner National Defense Authorization Act of 2007 established a goal for the DoD to perform cost estimating by full-time employees or members of the Armed Forces. As a result, the Air Force Under Secretary for Acquisition directed the service to identify current capabilities and ensure retention of the support capabilities currently completed by inorganic workers (contractors). The RAND Corporation conducted a census of the cost-estimating workforce and

published its report in 2009. The report highlighted many areas within the cost community and established a foundation of sorts for future comparisons.

The census indicated that in 2008 the AF cost-estimating workforce, comprised of 374 active duty, government civilian, and private contractors, relied heavily on contractors to produce initial cost estimates (Vernez & Massey, 2009). With just over 50% of the workforce being organic (military and civilian) personnel, the cost estimating community was dependent on the private contractor for operational success. This reality raised concern for the ability and likelihood of performing cost estimating through organic means. A second area of concern was the number of vacant positions reported by supervisors. The survey indicated that over 70 positions throughout the cost workforce remained vacant. This amounted to over 16% of the potential cost-estimating workforce as unfilled billets. WSARA drives the cost community toward increasing the number of organic workers, yet how likely is building the number given the preexisting abundance of vacant positions?

Another area highlighted by the survey was the experience of the cost analysts. The census reported that approximately 51% of the organic workforce had fewer than 5-years' experience (Vernez & Massey, 2009). Figure 1 below summarizes the information reported in the RAND census. Comparing organic personnel to contractors highlights serious differences in experience levels. Contractor experience remains largely consistent as a percentage for each experience range. However, organic personnel skew largely to the right with

approximately 70% of personnel having 10 years or less experience. Additionally, the percentage of organic personnel having greater than 20 years' experience is dramatically less than the contractor personnel.



**Figure 1: Experience as Reported in the RAND Census**

Specific cost-estimating certification was a second area of experience falling into an area of grave concern. The report stated that over two-thirds of the entire workforce lacked a cost-estimating certification. Between the numerous vacancies, the inexperience of the workforce, and the lack of certification, the cost estimating community was in a precarious position.

An area lacking study within the cost community is the way the current organizational structure affects efficiency. A great deal of academic research within the management community seeks to understand how various elements of interaction affect organizations.



Published research on leadership, motivation, leader member exchange, trust, and organizational commitment, among many other variables, all identify how companies might tailor and deliver information on policy changes to achieve the greatest support from workers. One developing area in research is the aspect that all companies rely to varying degrees on technical support for communication and production. As such, the virtualness of a company affects many areas of production and efficiency.

### **Virtualness**

Virtualness embodies multiple factors that create physical and psychological distance between members of an organization. Current literature identifies up to four primary dimensions, which influence the level of virtualness (Hertel et al., 2005; Erskine, 2007; Griffith et al., 2003; Fiol & O'Connor, 2005). One dimension of virtualness is team distance or separation. However, this distance is a complex variable in that it not only embodies just relative proximity of team members; distance also includes a mutual understanding of work environment and hierarchical separation (Erskine, 2007). A second dimension of virtualness is the reliance on technical support (Kirkman & Mathieu, 2005; Bell & Kozlowski, 2002; Griffith et al., 2003). Technical support includes multiple aspects, such as the use of electronic tools for communicating and work production. A third dimension of virtualness is the value of information provided by technology, henceforth known as technological richness (Carlson & Zmud, 1999; Griffith et al., 2003). A differentiation between the use of technology and the value added by said

technology allows for a more complete analysis of technological utilization in team environments. The fourth dimension is synchronicity of the team members (Kirkman & Mathieu, 2005; Hertel et al., 2005). Within the context of this paper, a team includes structured teams and also supervisor subordinate relations. The synchronicity among team members may vary from the synchronous communication found in face-to-face interactions to the asynchronous interactions in voicemail or email messages. Having introduced the four dimensions of virtualness, I will spend a few pages developing a greater knowledge of each.

### **Distance**

The aspect of distance inherent in the virtualness of a team, in its most simplistic form, is identifiable as physical proximity between members. Elementary measurements for distance limit understanding to mileage between members. However, a more thorough understanding of distance is required to appreciate the level of virtualness of a team. Physical proximity is but one aspect of distance, which creates separation of team members. Mutual understanding and agreement on work environment is a second aspect of distance. The cost analysis community of the AF presents an excellent example of how limiting distance to physical proximity fails to capture the complexity of distance. AF organizations often collocate teams of active duty personnel, civilian government service employees, and contractors. The proximity of these teams may be measured in feet; however, the team members understanding of work pressures differ greatly. The different types of personnel all experience differing forms of work stress and production

goals. As such, a more complete understanding of distance must include non-tangible aspects of distance.

### **Technical Support**

Reliance on technical support does not in itself determine a level of virtualness. Researchers argue that with regards to team or personal interaction, technical support augments the ability to convey information. A geographically dispersed team may be heavily dependent on technology to facilitate the progress of team goals (Erskine, 2007). Argumentatively, a geographically dispersed team may not use technology other than to communicate the time and location for the next team meeting. Since technological dependence may vary independent of physical location of team members, it cannot be a proxy for distance. As such, dependence on technology is a separate dimension of virtualness.

### **Richness of Technology**

Communication is vital to the success of a team (Carlson & Zmud, 1999). Technology allows a team to conduct many operations that previously required close proximity. However, the value of technology is dependent on the richness of the information relayed. If a team communicates through electronic mail, but the receiver of the message misunderstands the intent of the sender, then there is no value in the technology. Additionally, a great deal of communication is non-verbal, which may be lost in technology. In order to counteract the possible deterioration of richness, a team must ensure that the technology allows sufficient flexibility to meet all needs (Carlson & Zmud, 1999).

## **Synchronicity**

The literature surrounding synchronicity indicates that communications conducted in real time are synchronous. Instituting a delay into a communication chain creates an asynchronous exchange. A great deal of research into the implications of synchronicity of communication involves different aspects of the exchanging of information (Kirkman & Mathieu, 2005). Early researchers hypothesized that asynchronous relationships degraded the value of the communications. However, further research highlighted added value to asynchronous communications, which counteracts the degradation. Asynchronous communication allows for the tailoring of the message to convey the desired meaning (Kirkman & Mathieu, 2005). I must stress, synchronicity is not dependent specifically on the technology used to communicate. A computer may provide both synchronous communication in the form of instant messaging and asynchronous communication via email. It is counterintuitive that in the context of synchronicity, the almost archaic method of a handwritten and post mailed letter is more virtual than a cell phone call.

### **III. Methodology**

Chapter II provided information on the development of acquisition reform, studies on the effectiveness of reform, and the current hotbed that is virtualness. Chapter III introduces the methodology utilized to access virtualness and garners a greater understanding of the current work habits of the cost community. The methodology includes the rationale behind employing and developing a questionnaire. The discussion on the questionnaire contained within this chapter addresses the questionnaire itself; the collected results and analysis appear in Chapter IV.

#### **Methodology**

A meta-analysis of selected acquisition reports or previous studies fails to achieve a complete understanding of the atmosphere present within the cost community. The few studies available for analysis fail to achieve the depth necessary to present greater than a cursory explanation of time allocation. The hypotheses studied within this paper were tested utilizing data acquired through an online questionnaire. The data sample of the cost analysis community, which includes approximately 400 individuals, 333 of which personnel received the invitation to complete the questionnaire. The cost acquisition community consists of four primary headquarter organizations and three operating locations.

The dispersion of the personnel presents excellent applicability to developing the virtualness measure. The four primary locations include Hancsom AFB located in Boston, Massachusetts, Air Force Cost Analysis Agency located in

Washington, D.C., Wright Patterson AFB located in Dayton, Ohio, and Los Angeles AFB located in Los Angeles, California. The three operating locations include Oklahoma City Air Logistics Center, Ogden Air Logistics Center, and Warner-Robins Air Logistics Center. Beyond the physical separation of the location, the military environment introduces hierarchical and cultural discontinuities between personnel.

## **Measures**

The questionnaire requested individuals to rate appropriately utilizing a five-point Likert-type scale from 1 (strongly disagree) to 5 (strongly agree) unless otherwise noted. This study adapted existing measures of proven reliability and accuracy. Appendix D presents the questionnaire in document form.

## **Questionnaire**

This study employed two similar questionnaires in order to accurately assess the cultural nuances contained with the cost analysis community. Multiple benefits arose from the necessity of tailoring a separate questionnaire for the supervisor and the subordinate. The two questionnaires allowed for a matched-pair comparison of measures, ultimately ensuring reliability of the created virtualness measure.

Chapter 4 of this paper includes more specific discussion surrounding the results of the matched-pair study. Limitations encountered during the participant selection phase excluded pre-determining which participants supervised individuals. As such, the web-based survey utilized a branched design in which the participant selected the applicable questionnaire. Participants indicated supervisory

responsibilities in question 1 of the survey; as a result, those individuals who indicated responsibility for supervising others completed the questionnaire targeting supervisors. The description of individual measurement items explains the specific adaptations for supervisor or non-supervisor questionnaire.

## **Trust**

The trust measures for non-supervisor participants are an adaptation of institutionally accepted questions as tested by Ballinger, Schoorman, and Lehman (2009). Cognitive-based trust items capture the perception of the subordinate regarding the established track record of the supervisor. Affect-based trust measures seek an understanding of the relationship between supervisor and subordinate. Affect-based trust is less about the actual performance and more about likability or fondness. The non-supervisor questionnaire utilizes seven items specifically addressing trust towards the supervisor. One example item is, “My supervisor keeps my interests in mind when making decisions.”

Trust measures for participants who indicated supervisory responsibilities utilize five of the same items as the non-supervisory questionnaire. Adapting the items for supervisors primarily involved replacing the term supervisor with subordinate. A sample item for the supervisor is, “It is important for me to have a good way to keep an eye on my subordinate.” In order to keep the completion time of the questionnaire manageable, the supervisor portion only uses five of the seven trust items.

## **Leadership Member Exchange (LMX)**

The inclusion of LMX hinges on recent literature indicating a correlation between virtualness and LMX (Erskine, 2007; Howell & Hall-Merenda, 1999). Virtualness as a moderator of LMX indicates that strong leadership may overcome the negative effects of virtualness (Kirkman, Rosen, Tesluk, & Gibson, 2004). The questionnaire utilizes eight items adapted from Liden, Wayne, and Stilwell (1993). A sample measure is, "I know where I stand with my supervisor."

## **Job Satisfaction**

Job satisfaction measures appear on the non-supervisor questionnaire while absent from the supervisor questionnaire. Including four items adapted from Weiss, Nicholas, and Daus (1999) allowed for greater control on variables modified by virtualness. (1999). A sample measure for job satisfaction is, "All in all I am satisfied with my job."

## **Turnover Intentions**

Turnover intention items stem from an adaptation of Wayne, Shore, and Liden (1997). The supervisor questionnaire excludes turnover intentions as a measurement item. A sample question for turnover intentions is, "I am seriously thinking about quitting my job." The questionnaire includes five items specifically tailored to measure turnover intention.

## **Organizational Commitment**



Organizational commitment items included in the non-supervisor questionnaire originate from the 1997 book *Commitment in the Workplace* (Meyer & Allen). The questionnaire utilizes eight items in the assessment of non-supervisors' commitment to the organization. A sample item is, "I would be happy to spend the rest of my career with this organization."

### **Leader Appraisal of the Member's Performance**

The supervisor questionnaire utilizes four items adapted from the Liden et al. study of leader appraisal of the member's performance (Howell & Hall-Merenda, 1999). Supervisors completed the measures for each military and government civilian subordinate. A sample measure is, "This subordinate is superior to other subordinates I have supervised before."

### **Virtualness (adapted from (Carlson & Zmud, 1999)**

The virtualness portion of the questionnaire differs from other measures in that the underlying goal is to develop a universal measure. Scholars dispute exactly which dimensions directly measure virtualness. The questionnaire seeks to gain a further understanding of virtualness by developing an accurate measure of assessing all dimensions. In order to create this measure, the questionnaire contains a vastly increased number of questions in each of the four dimensions of virtualness. My goal in this effort is to differentiate between each of the four underlying dimensions of virtualness and develop a measure for each.

### **Distance**

1. My supervisor thoroughly understands my working environment.
2. My supervisor works within close physical proximity to me.
3. My team members understand my job requirements.
4. I really understand why people behave the way they do in my organization.
5. I often interact with team members not co-located with me.
6. I have a good understanding of the environment in which my organization operates.
7. Time zones add difficulty to my work.
8. My supervisor understands the daily requirements of my job.
9. My supervisor and I have a common understanding of work requirements.
10. I have a good sense of the dynamics within my organization.
11. I know what other people in my organization are doing.

### **Technical Support**

12. My supervisor carries an email-enabled smartphone such as a Blackberry™.
13. I am unable to communicate with my team/supervisor without electronics,; telephone, computer, etc.
14. My supervisor is available on a cell phone throughout the workday.
15. I primarily communicate with my team members through email.
16. I use email to communicate with my supervisor.
17. I primarily complete my work through computers.

- 18. I contact my supervisor through telephone conversations.
- 19. Without computers I would be unable to accomplish my job.
- 20. I utilize information technology in my daily interactions with my supervisor.
- 21. My supervisor carries a cell phone.

**Richness of technology**

- 22. I often speak in person with my supervisor to clarify messages received through electronic formats.
- 23. Utilizing email makes it difficult to understand the tone of messages from my supervisor.
- 24. I am easily able to understand a variety of different cues (e.g., emotional tone, feelings) from my supervisor.
- 25. I often seek instructions sent via email from my supervisor regarding work requirements.
- 26. I am easily able to understand the message from my supervisor.
- 27. I am easily able to tailor my messages to my supervisor.
- 28. I often speak in person with my coworkers to clarify messages received through electronic formats.
- 29. I am able to use rich and varied language when communicating with my supervisor.
- 30. It is easy to exchange timely feedback with my supervisor.
- 31. I am easily able to maintain multiple conversations with co-workers/supervisors.

### **Synchronicity**

- 32. It negatively affects my work when my supervisor is absent.
- 33. My supervisor is available whenever I need him/her.
- 34. My supervisor's work schedule is in-synch with my own work schedule.
- 35. My supervisor answers my questions on the same day I send the email.
- 36. It is often difficult to get in touch with my supervisor.
- 37. My supervisor and I often have misunderstandings driven by the differences in our schedules.
- 38. My supervisor and I have difficulties aligning our schedules.
- 39. My schedule changes are based on my supervisor's schedule.
- 40. My supervisor and I always seem to be in tune as to what we are doing.
- 41. My supervisor responds to my messages (e.g., phone, email) in a timely manner.

## IV. Analysis and Results

### Chapter Overview

As previously discussed, the cost analysis community endures a myriad of accusations surrounding the seemingly endless growth in cost for DoD major weapon acquisitions. As such, I hypothesized that there is a correlation between the organizational structure of the cost analysis community and virtualness. Furthermore, the level of virtualness apparent in the cost community impacts the ability to produce accurate, efficient cost estimates. Table 3 below summarizes the hypothesized relationships between virtualness and various facets of individual behavior.

Table 3: Hypothesized Relationships of Virtualness

Summary of expected correlations		
Factor	Independent Variable	Relationship
Virtualness	Trust	-
Virtualness	Job Satisfaction	-
Virtualness	Organizational Commitment	-

### Analytical Approach

As accepted definitions and measures for virtualness vary within the academic discipline, this research aims at creating a reliable measure. The initial creation of the measure adapts accepted individual dimension measures where applicable, as in the case of media richness (Carlson & Zmud, 1999). The questionnaire includes 41 individual measures for virtualness divided among the four dimensions. All dimensions, except for distance, contain 10 questions with

distance using 11. Distance is comprised of two factors, physical distance and psychological distance, thus requiring an additional question. Ultimately, the measure uses only 16 questions in hopes of simplifying the data gathering process in future questionnaires. While the structure of questionnaire allowed for a matched-pair comparison between data sets, the limited sample set precludes this use. Alternatively, I employ structural equation modeling to analyze the results and create a measure of virtualness.

Utilizing reliability measures as well as face validity and statistical analysis, results in the reduction of the 41 questions to approximately four questions per dimension. Once reducing the individual measures to approximately 16 questions, I utilized structural equation modeling to confirm the relationships. I am examining how the four dimensions of virtualness combine into a measure of virtualness. The measure allows for further exploration into how virtualness effects trust, organizational commitment, and job satisfaction. The correlation between the independent variables and the detrimental variable of turnover intention should not be understated. Figure 2 below depicts the anticipated model and effects of the independent variable virtualness and turnover intentions. However, in addition to the anticipated relationship between virtualness and turnover intention, a qualitative assessment of the gathered results is necessary for a complete understanding of the unquantifiable steps taken to counteract the negative views of the cost community.



**Figure 2: Relationship Diagram from Virtualness to Turnover Intention**

## **Results**

### **Cost Analysis Community**

The purpose of this section is to report the results of the information gathered from both the supervisor and non-supervisor questionnaires. The supervisor questionnaire contains many qualitative questions seeking to gain an understanding of the current condition of the cost estimating community. This section summarizes and when applicable compares the results to the RAND study (Vernez & Massey, 2009). Primarily, the questionnaire focuses on one underlying aspect, time utilization.

### **Time Usage**

Similar to the RAND study, my questionnaire asks respondents to indicate how they spent their work time for the last six months. While this creates an estimate of historical time utilization in a single point, comparing the results against the RAND study allows for a quasi-longitudinal view. I must state that while the RAND labels its study as a census and includes contractors, the questionnaire

completed for this thesis sampled only military and civilian cost estimators. The census raises a reasonable point when stating that as cost estimating requirements change based on many external factors (program age, funding amounts and requirements, congressional oversight, etc.), averaging the responses allows for a close approximation of general cost analysis time utilization (Vernez & Massey, 2009). Table 4 below reports the time usage findings of the RAND census.

**Table 4: Time spent on cost analysis (Vernez & Massey, 2009)**

<b>Time Spent Doing Cost Estimation Over Previous Six Months, by Personnel Type, 2008 (%)</b>							
Personnel Type	None	Less than 25	25 to 49.9	50 to 74.9	75 to 99.9	100	Total
Organic (n=184)	5	17	17	12	14	35	100
Contractor (n=190)	1	10	2	8	47	32	100
All (n=374)	3	13	9	10	32	33	100

SOURCE: RAND census, 2008.

NOTE: Percentages may not add to 100 because of rounding.

Table 4 above shows time spent on cost estimating; however, the RAND study fails to identify what tasks it considers cost estimating. The questionnaire designed for this thesis includes a matrix-like breakout of 14 tasks. I developed these tasks through preliminary interviews with current cost estimators. Table 5 below shows the matrix included in the cost questionnaire.



**Table 5: Non-Supervisor Time Matrix Questionnaire**

Within the last 6 months, what % time spent on following activities:		% Time
a.	% time spent analyzing Earned Value Management (EVM) data (i.e., CPR, CSSR) using Winsight or other program in support of program management	
b.	% time spent using Earned Value (EV) data in support of creating estimates	
c.	% time spent doing non-cost-related financial management	
d.	% time spent managing support contractors	
e.	% time consulting with PM or personnel in other departments to discuss and formulate estimates or resolve issues	
f.	% time preparing initial estimates	
g.	% time reconciling estimates with either AFCAA or OSD	
h.	% time reviewing estimates	
i.	% time completing post estimate documentation	
j.	% time completing what-if drills for PM due to program changes or budget constraints	
k.	% time spent in meetings	
l.	% time training (relating to cost only; include both time spent in training and time spent training others)	
m.	% time spent in non-cost-related training (annual training – Information Protection, Human Trafficking, etc; do not include time spent doing cost-related training)	
n.	% time Other _____	
<b>Total: Must add up to 100%</b>		<b>0%</b>

These 14 items include tasks directly related to cost estimation as well as general work activities. In order to compare the responses gathered from the questionnaire against the RAND census, I have assigned items a, b, e, f, g, h, i, and j to cost estimating activities. I excluded item k from the comparison of time utilization, since may include both cost-related and non-cost-related meetings. Table 6 below compares the RAND findings against the time utilization of organic personnel reported through the questionnaire.

Table 6: Time Usage Comparison Between RAND and Research

Time Spent Doing Cost Estimation Over Previous Six Months							
	None	< 25%	25 to 49.9%	50 to 74.9%	75 to 99.9%	100%	Total
RAND *	5%	17%	17%	12%	14%	35%	100%
<b>Thesis Study</b>	<b>2%</b>	<b>3%</b>	<b>14%</b>	<b>42%</b>	<b>38%</b>	<b>0%</b>	<b>100%</b>
<b>Thesis Study **</b>	<b>1%</b>	<b>2%</b>	<b>7%</b>	<b>21%</b>	<b>68%</b>	<b>1%</b>	<b>100%</b>
*SOURCE: RAND census, 2008. ** Indicates "Cost estimating time plus "time spent in meetings" NOTE: Percentages may not add to 100 because of rounding							

The questionnaire results highlight a major flaw in the RAND study. RAND indicates approximately 35% of organic personnel spend 100% of their time on cost estimating tasks. Perhaps the nature of the RAND study differs from the questionnaire; nevertheless, my findings differ greatly. By coding the previously mentioned questionnaire items as cost estimating tasks, no respondents indicate they spend 100% of their time on cost estimation. Also of significance is the percent of personnel who report spending less than 25% of their time on cost estimating tasks. The questionnaire presented 14 different activities for time allocation and only 5% of respondents indicated they spent less than 25% of their time doing cost-estimating activities. For completeness, the third row in Table 4 shows the percentage of time utilization when including "time spent in meetings." This skews the data and shows a much higher percentage of personnel spending over 75% of their time in cost estimating activities.

Figure 3 below graphically compares the time utilization per category for military and civilians as reported by the employee. The primary goal of the time utilization portion of the questionnaire is to identify how the analyst spends time.

As such, asking supervisors to report their time utilization failed to achieve the desired result. Instead, the questionnaire instructed supervisors to breakout how their cost analysis team utilizes its time.

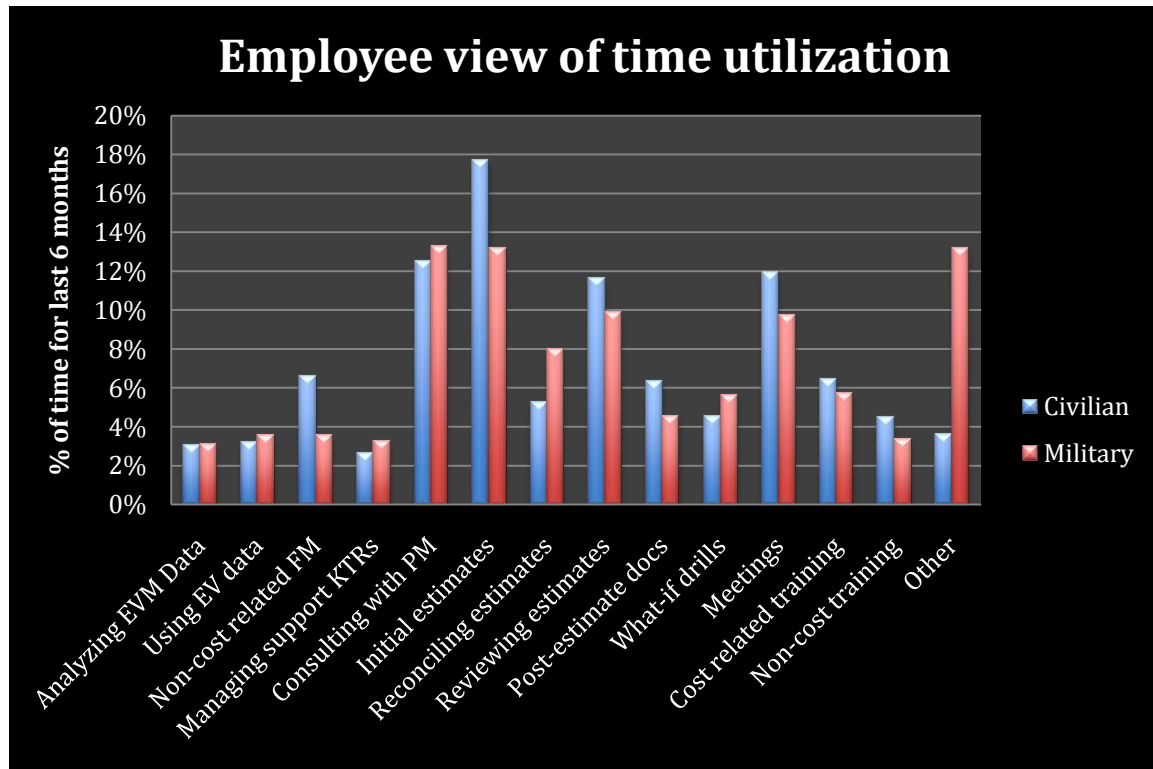


Figure 3: Aggregate of Time Usage as Reported by Employee

While Table 5 above shows the questionnaire matrix presented to the non-supervisory personnel, Table 7 below shows the matrix completed by supervisors. The questionnaire asks supervisors to indicate how many employees for each of the four categories they supervise. The supervisor then indicates what percentage of time each personnel category spends on the 14 individual tasks. The 14 individual tasks are consistent with those presented to non-supervisory personnel. The primary difference of viewpoint creates an excellent opportunity to identify areas of differing opinion.

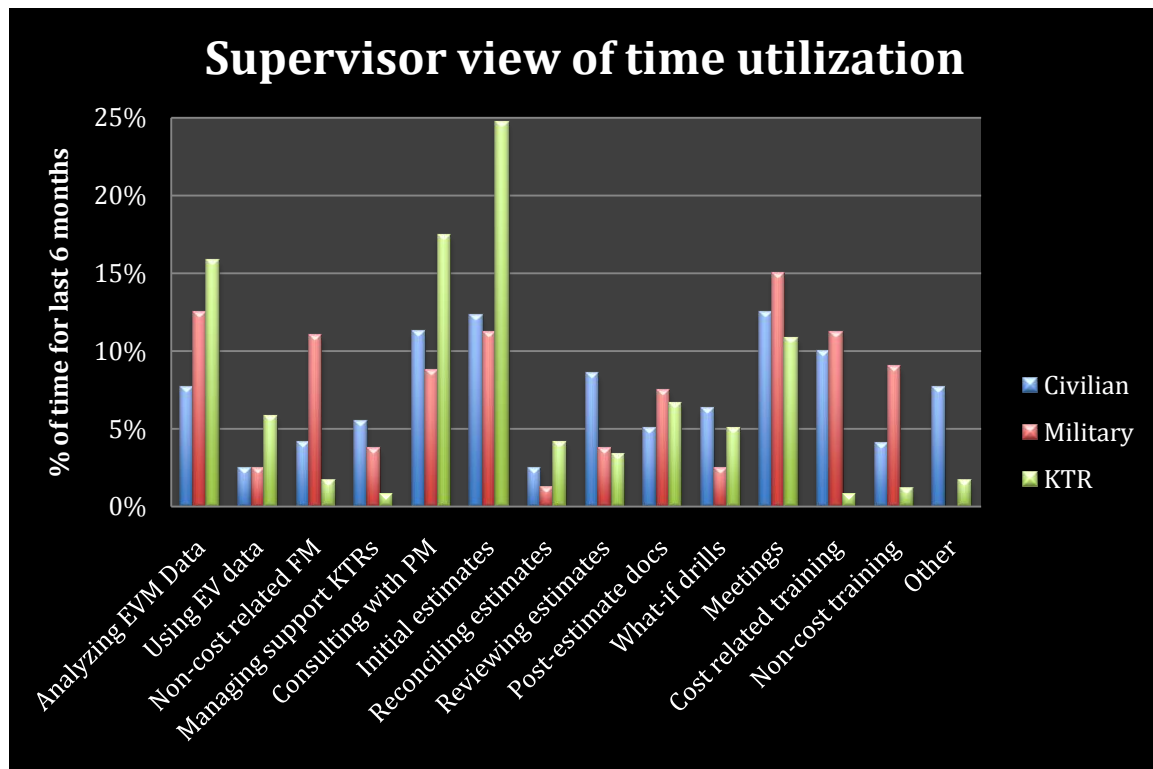
**Table 7: Supervisor Time Matrix Questionnaire**

Number employed of each		Civilian	Military	Contractor	FFRDC
Within the last 6 months, what % Time spent on following activities:		% Time	% Time	% Time	% Time
a.	% time spent analyzing Earned Value Management (EVM) data (i.e. CPR, CSSR) using winsight or other program in support of program management				
b.	% time spent using Earned Value (EV) data in support of creating estimates				
c.	% time spent doing non-cost related financial management				
d.	% time spent managing support contractors				
e.	% time consulting with PM or personnel in other departments to discuss and formulate estimates or resolve issues				
f.	% time preparing initial estimates				
g.	% time reconciling estimates with either AFCAA or OSD				
h.	% time reviewing estimates				
i.	% time completing post estimate documentation				
j.	% time completing what-if drills for PM due to program changes or budget				
k.	% time spent in meetings				
l.	% time training (relating to cost only: included both time spent in training and time spent training others)				
m.	% time spent in non-cost related training (annual training – Information Protection, Human Trafficking, etc; do not include time spent doing cost related				
n.	% time Other _____				
<b>Total: Must add up to 100%</b>		<b>0%</b>	<b>0%</b>	<b>0%</b>	<b>0%</b>

While only 19 supervisors completed this portion of the questionnaire, they indicated they supervise a total of 122 organic and 59 contractor personnel. As such, they represent a significant sample of the cost estimating supervisory personnel. Table 8 below shows the mean totals for each of the 14 time categories broken out by employee versus supervisor and civilian, military, and contractor. The table requires the number of personnel within each employment category above the % Time columns. The total number of employees reporting in the survey is 105, and the supervisors report on a total of 181 individuals, including contractors.

Figure 4 below shows the reported time usage for the cost analysis team viewed from the supervisors' standpoint. As the figure indicates, supervisors estimate that contractors spend considerably more time than organic personnel on the task of actual initial estimate creation. Understandably, supervisors indicate

that contractors spend less time on training and managing other support contracts. Interestingly, supervisors returned information indicating that, for the most part, military and civilians spend similar percentages of time for most tasks. One large note of difference is with supervisors indicating military spend considerably more time in the area of non-cost-related FM activities.



**Figure 4: Aggregate of Time Usage as Reported by Supervisor**

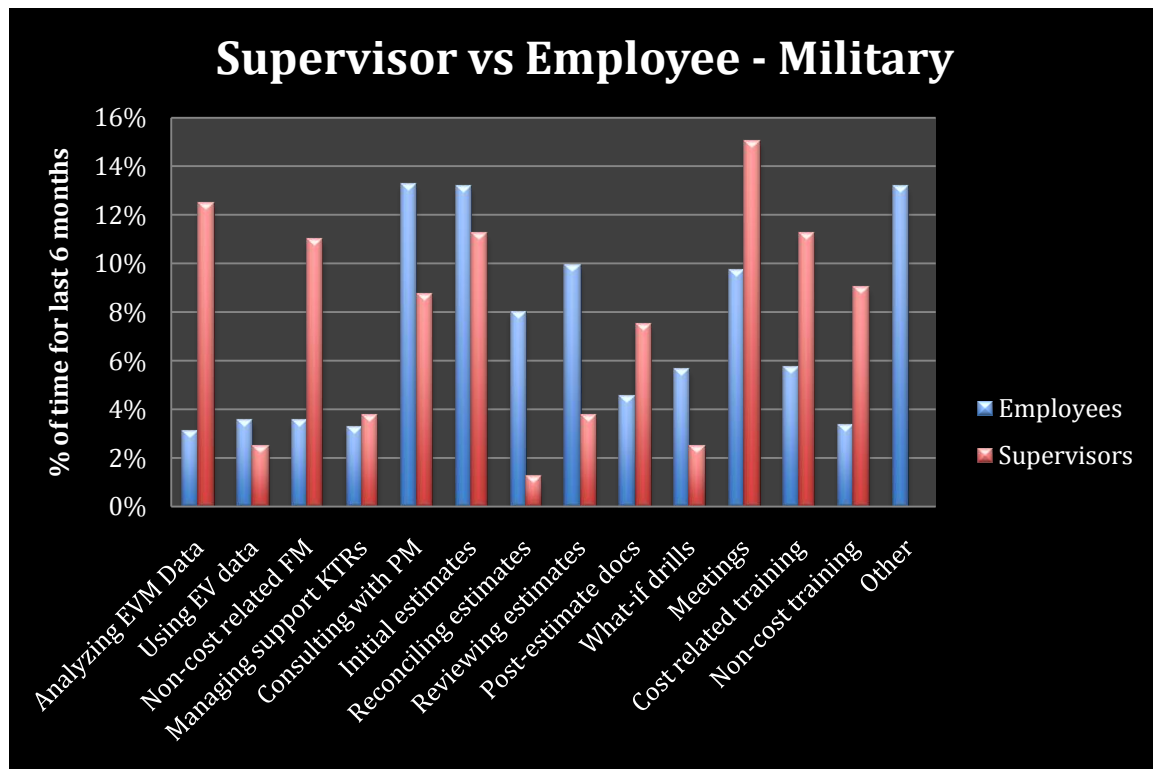
While the comparison against the RAND census highlights some interesting aspects of reported time utilization, comparing the non-supervisors versus supervisors' responses allows for an alternative assessment. Question 1 of the survey asks the respondent if he or she supervises personnel. Based on the answer, supervisors completed a similar but more qualitative questionnaire. One of the supervisor-specific aspects of the questionnaire is to indicate the number of

personnel supervised (broken into four categories: military, civilian, contractor, and Federally Funded Research and Development Centers – FFRDC) and to indicate how much time individuals in each category spend on the 14 tasks. Table 8 below summarizes the mean percent reported per category as well as personnel group. The lack of FFRDC under supervisors is due to the lack of data. Not a single supervisor indicated his or her cost team contained FFRDC personnel. Comparing the mean time per category within personnel groups shows that for the most part supervisors estimate the time utilization with much the same breakdown as employees. As mentioned earlier, the largest single mean percentage of time is with contractors preparing initial estimates at an incredible 25%.

**Table 8: Aggregate Time Usage Matrix**

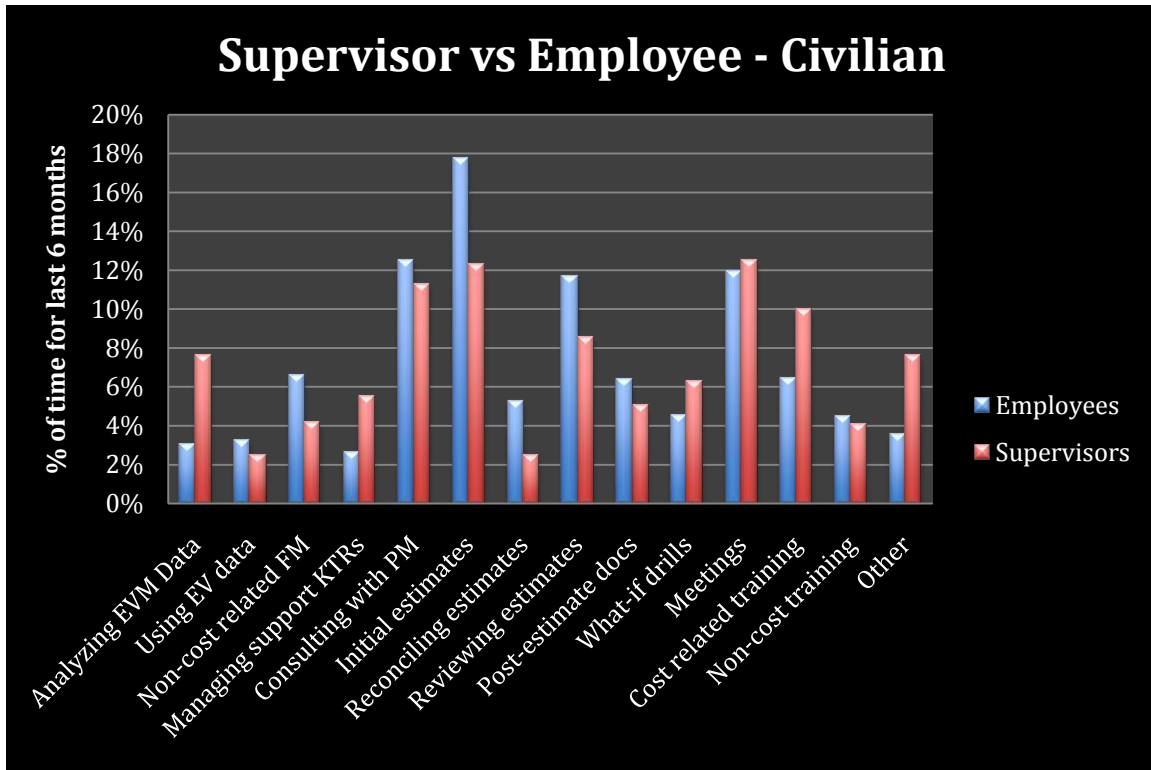
	Employees		Supervisors		
	11	94	109	13	59
	Civilian	Military	Civilian	Military	KTR
Analyzing EVM Data	3%	3%	7%	13%	16%
Using Earned Value (EV) data	3%	4%	2%	3%	6%
Non-cost-related FM	7%	4%	4%	11%	2%
Managing support contractors	3%	3%	5%	4%	1%
Consulting with PM	13%	13%	11%	9%	18%
Preparing initial estimates	18%	13%	11%	11%	25%
Reconciling estimates	5%	8%	2%	1%	4%
Reviewing estimates	12%	10%	8%	4%	3%
Post-estimate documentation	6%	5%	5%	8%	7%
What-if drills	5%	6%	6%	3%	5%
Meetings	12%	10%	12%	15%	11%
Cost-related training	6%	6%	9%	11%	1%
Non-cost-related training	4%	3%	4%	9%	1%
Other	4%	13%	14%	0%	2%
Total	100%	100%	100%	100%	100%

Figure 5 below compares the mean time reported by military employees against the estimated percentage breakout as reported by supervisors. The supervisors indicated a very different time allocation when compared to the military employee's time usage. Average times on the linear graph do not seem to follow or mirror each other.



**Figure 5: Time Allocation Comparison for Military Against Supervisor Expectation**

Figure 6 below contains the same information as Figure 4 above except it compares civilian employees' reported time utilization against the supervisors' estimation. Unlike the military figure above, the estimated utilizations between the supervisor and employee largely trend in a similar fashion. Only in one or two categories does the time vary to a significant amount. The following paragraphs discuss the specific difference between various employment categories.



**Figure 6: Time Allocation Comparison for Civilian Against Supervisor Expectation**

While ignoring the supervisors' indications of contractor time utilization, comparing supervisor impression against employee average utilization in many categories is very similar. Utilizing earned value (EV) data in support of creating estimates is essentially the same for all. However, there are some large disparities in the results. Table 9 below shows the difference between the supervisor impression of time utilization and the employee indication of activities. The table is highlighted in pink for any areas where the supervisor and employee disagree by 5% or greater. The category "analyzing EVM data" indicates that the military feel on average that they spend 9% less time than what the supervisor estimates.



**Table 9: Time Comparison of Supervisor Expectation Versus as Reported by Employee**

Difference of Opinion		
	Civilian	Military
Analyzing EVM Data	5%	9%
Using EV data	1%	1%
Non-cost related FM	2%	7%
Managing support KTRs	3%	0%
Consulting with PM	1%	5%
Initial estimates	5%	2%
Reconciling estimates	3%	7%
Reviewing estimates	3%	6%
Post-estimate docs	1%	3%
What-if drills	2%	3%
Meetings	1%	5%
Cost related training	4%	6%
Non-cost training	0%	6%
Other	4%	13%

The table above suggests that supervisors maintain a strong understanding of the way civilian employees spend their time. However, in the case of military employees, supervisors' expectations seem to differ significantly from the employees' reported usage. Table 9 above shows that supervisors over or underestimate military time by 5% in 9 of the 14 categories. It is outside the capability of this study to determine the exact misunderstanding for each category since the supervisors summarize utilization per personnel and not on individual employees. However, the questionnaire does present useful information, which allows for further exploration of time allocation. In the case of one military respondent, the only category to receive a percentage weight was "Other" as the

individual deployed to an overseas location and did not complete any cost estimating activities.

The employee versus supervisor disparity in time expectations continues in many areas when analyzing the data on a base level. Figure 7 below shows the results of the civilian employees from Los Angeles Air Force Base (LAAFB) versus the supervisors' expectations. The data includes 10 civilian employees and supervisors' rating on 7 civilian subordinates. Interestingly the supervisors indicate civilian employees spend a little over 30% of time analyzing EVM data. The civilian employees report only 17% of time spent analyzing EVM data. The other interesting disparity resides in initial estimates. Again, supervisors expect a large percentage of time spent in this category. The difference of almost 8% between the supervisors and employees causes concern.



**Figure 7: Time Usage Expectations at LAAFB**

In every location analyzed, at least one category varies by a substantial percentage between the supervisor and employee report. Initial indications point to a lack of awareness between the supervisor and the employee. However, a matched-pair analysis is not possible in the limited data set. The supervisors at LAAFB might be reporting time usage of employees different from the employees who completed the survey. Appendix E contains the data in percentage of time broken out by base.

### **Experience**

A second area highlighted by the RAND study is experience or lack of experience within the cost community. The RAND census gathered slightly different information in both personnel and in experience levels. However, comparing the

two studies highlights some interesting differences. While the studies are purely snapshots in time, the fact that the Cost Community Questionnaire followed the RAND census by almost three years allows for a longitudinal look at any changes that may have taken place in the acquisition community. Figure 8 below shows the RAND census information in numbers of personnel. RAND summarized its information regarding personnel as either organic or contractor. The organic group contained both military and government civilians. The RAND census maintained similar numbers of both organic personnel and contractors, with the total number being 358 people split evenly (180 organic and 178 contractors).

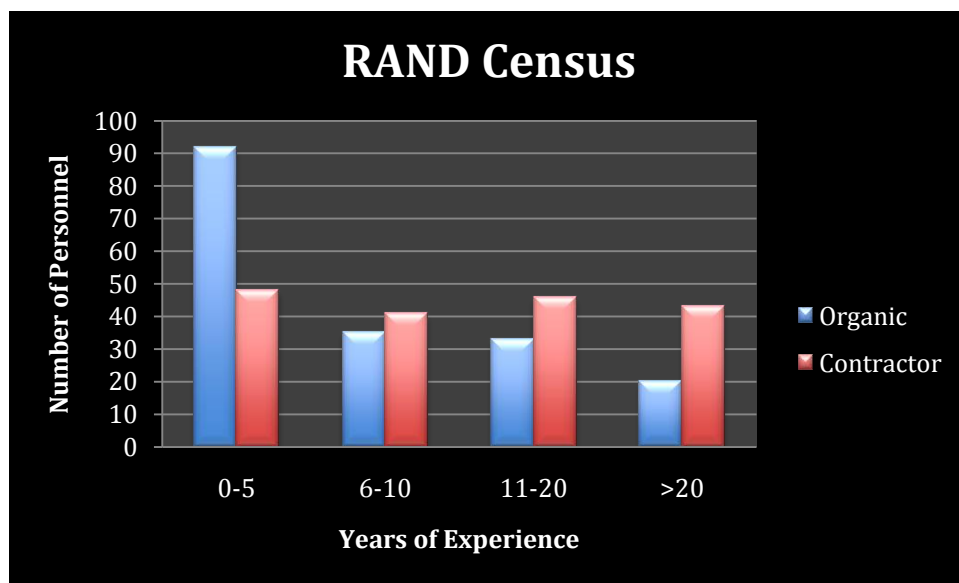
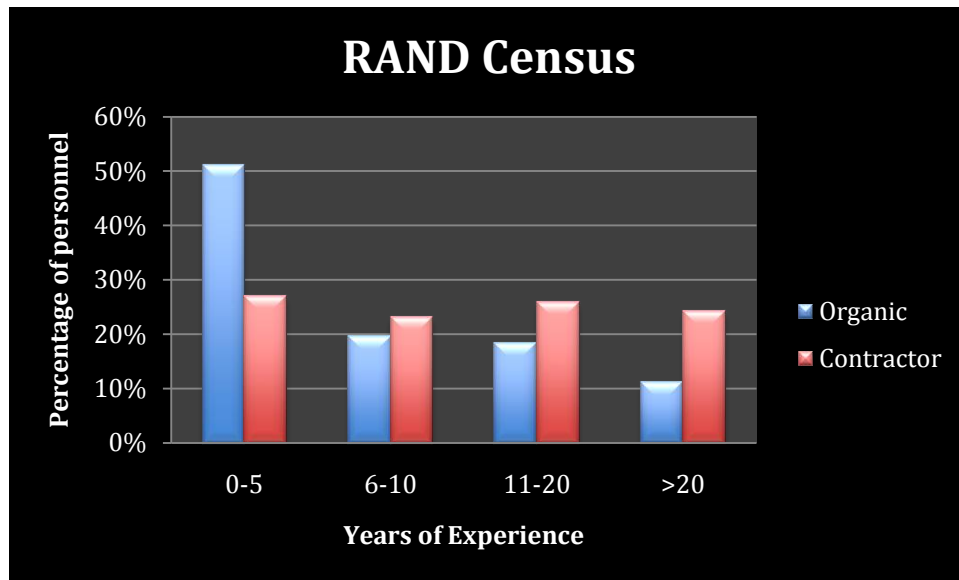


Figure 8: Number of Personnel per Experience Bin as Reported in RAND Census (Vernez & Massey, 2009)

Figure 8 above also shows a large disparity between the number of organic personnel with five years or less of experience and that of the contractors. Figure 9 below reformats the information into percentage of personnel based on the number

of years of experience. Contractors maintain around 25% of personnel in each of the four experience groupings. However, as figure 9 below highlights, organic personnel are nowhere near as evenly distributed. Individuals with five years or less of experience account for over 50% of the total organic workforce.



**Figure 9: Percentage of Personnel per Experience Bin as Reported in RAND Census (Vernez & Massey, 2009)**

The reason for discussing the RAND census data is to establish a point of comparison. Figure 10 below shows the information gathered from the 2010 survey. Civilians comprise the bulk of the cost community with a ratio of 5 to 1 versus the military who completed the questionnaire. Figure 10 includes supervisors with the idea that a more experienced supervisor will allow for a more complete cost analysis team. The number of civilians in each category of experience seems to mimic a learning curve function utilized in cost estimation.

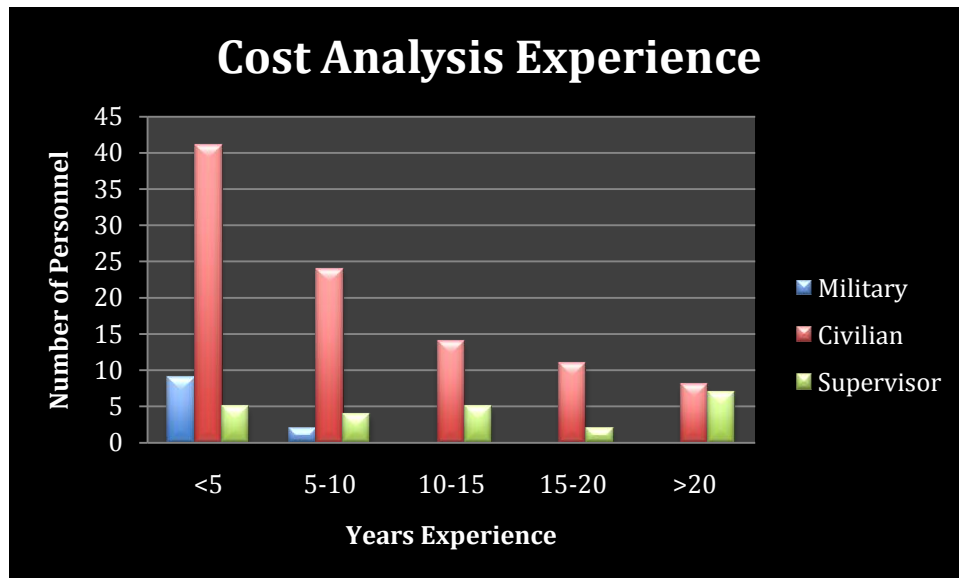


Figure 10: Number of Personnel per Experience Bin as Indicated in Questionnaire

The Pareto chart (Figure 11) below summarizes the experience contained in the cost analysis community as percentages. The percentage of military cost analysts with five years or less of cost experience is an alarming 81%. The civilians fare much better at a 41% rate in the same category. As represented, no military with greater than 10 years of experience completed the questionnaire. The line increasing towards the right represents the cumulative total of military and civilian analysts in non-supervisory positions. Non-supervisory personnel with 10 years or less of experience account for 70% of the total cost estimating organic workforce. Only 17% of the workforce had greater than 15 years of experience. Even when including the supervisory personnel in the total, approximately 64% of personnel have 10 years or less of experience. Supervisors raise the percentage of the workforce with greater than 15 years of experience from 17% to 21%.

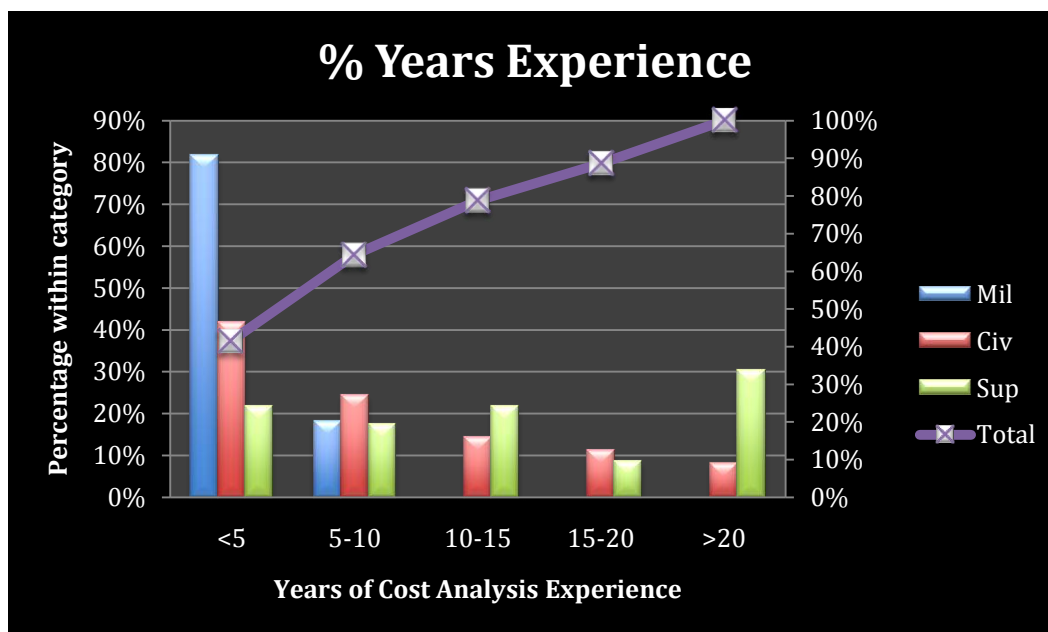


Figure 11: Percentage of Personnel per Experience Bin as Indicated in Questionnaire

Comparing the point estimate created in the RAND census and the recently acquired data creates a longitudinal view. Figure 12 below shows the RAND census in red and the cost questionnaire results in blue as percentage of the total organic workforce. For comparison against the RAND study, which included “cost leads” in the organic personnel, I include the supervisory personnel in the questionnaire numbers. Within the category of five years of experience or less, the RAND census reported a higher percentage than the questionnaire. As such, the questionnaire reports a higher percentage of personnel in both the 6-10 and 11-20 year range. One explanation for this is that some of the individuals remaining in the career field and gaining years of experience between the two studies. The personnel with greater than 20 years of experience remains largely unchanged between the two studies.

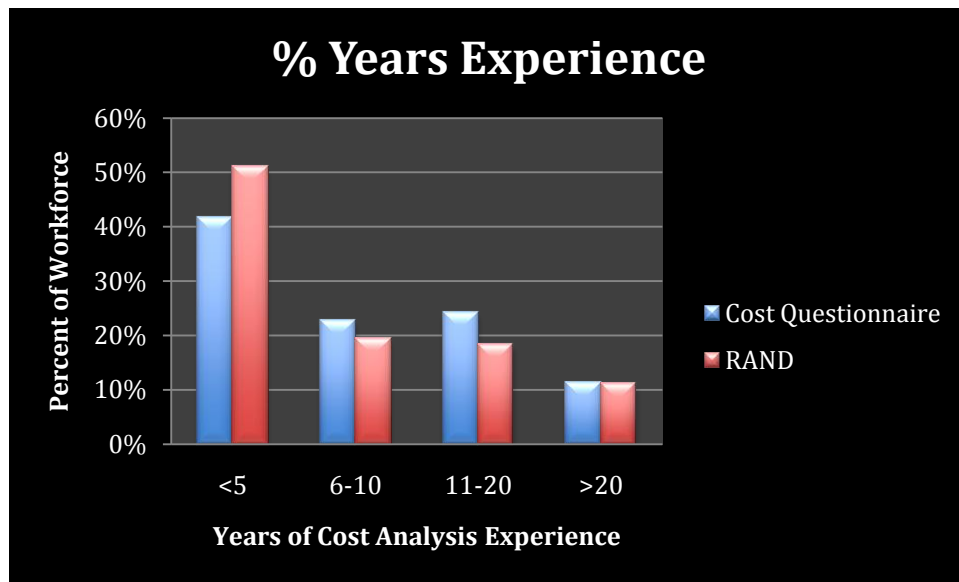
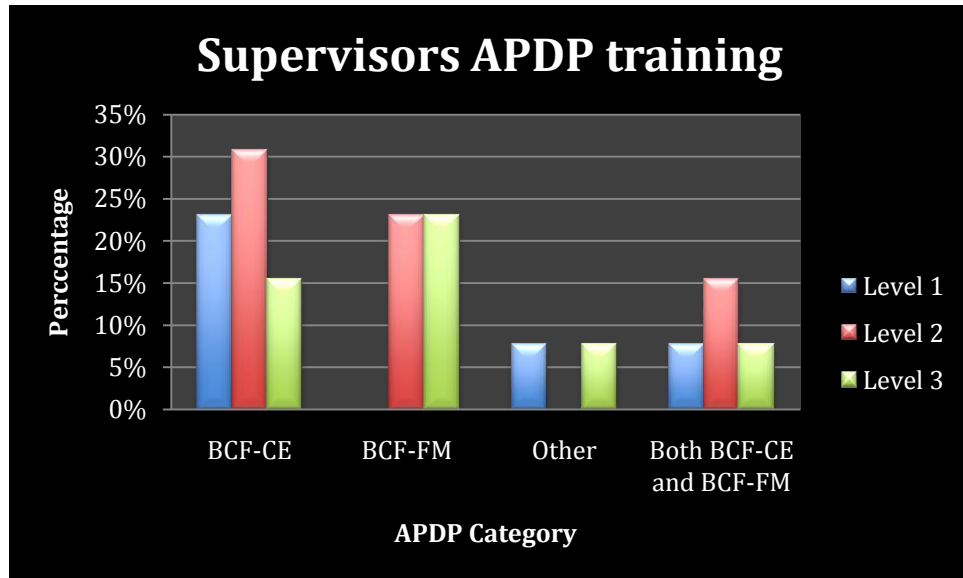


Figure 12: Comparison of RAND Census Versus Questionnaire

### Training

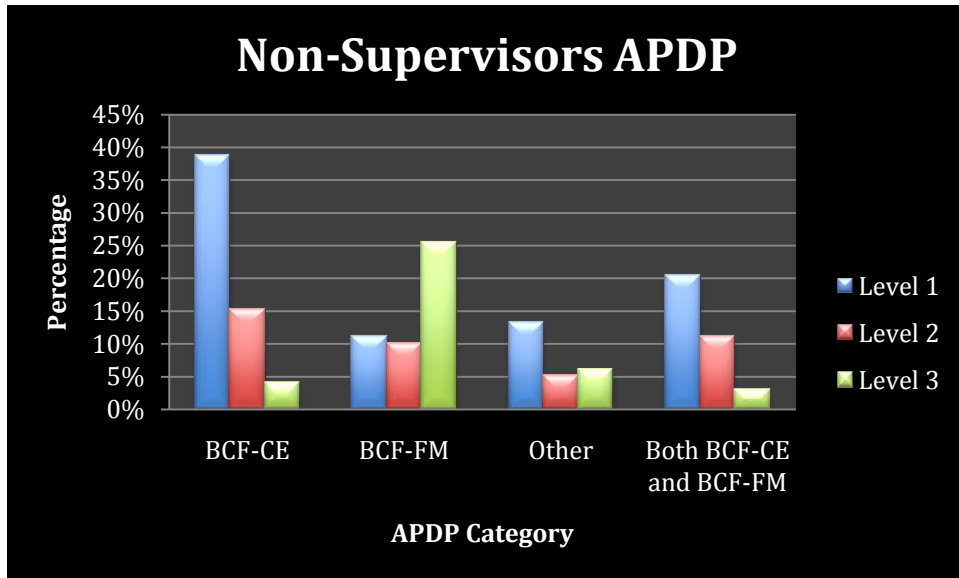
For the purposes of the online questionnaire, Acquisition Professional Development Program (APDP) levels serve as a proxy for training. Of all supervisors, 85% hold APDP in at least one category while only 76% of non-supervisory personnel hold at least one level of APDP of any certificate. Figure 13 below shows that approximately 70% of supervisors maintain an APDP certification of some level in the cost specialty. The column indicating both career field cost estimating (BCF-CE) and financial management (BCF-FM) APDP levels shows the lowest level of either category. If a supervisor indicated a BCF-CE level 2 and a BCF-FM level 3, the figure below categorizes this as a level 2 in both. Over 30% of supervisors indicated both a BCF-CE and a BCF-FM.





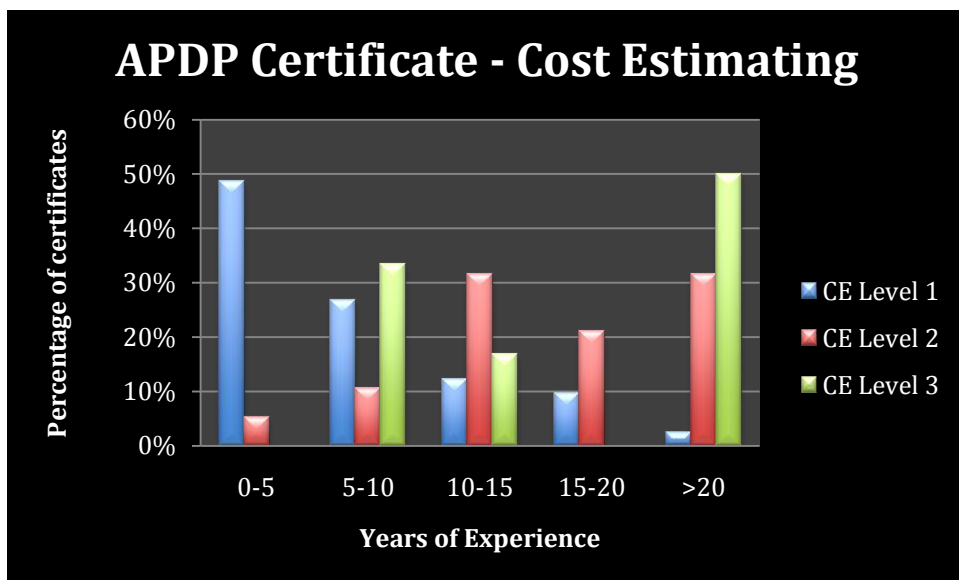
**Figure 13: Supervisor APDP Training Levels as Reported in Questionnaire**

Non-supervisory personnel reported that approximately 60% maintain at least some level of BCF-CE level. As with Figure 13 above, Figure 14 summarizes the results for APDP training levels. Compared to supervisors, a larger percentage of non-supervisory personnel maintain both BCF-CE and BCF-FM. Of non-supervisory personnel, 35% reported they completed some level of certification in both BCF-CE and BCF-FM. The lowest level of certificate indicated by the respondent comprises the levels show in the “both” column.



**Figure 14: Non-Supervisor APDP Training Levels as Reported in Questionnaire**

Additionally, over 50% of supervisors either reported having a certified defense financial management (CDFM) or certified cost estimator/analyst (CCEA) certificate. Only 20% of non-supervisory personnel indicated a certification, split evenly between CDFM and CCEA.



**Figure 15: Experience Level Compared to Maximum APDP Certificate Level – CE**

Figure 15 above expands upon the analysis of training within the cost community. The y-axis represents the percentage of certificates per level with the x-axis indicating the years of experience indicated by respondents. The CE-level 1 certificate decreases at an almost linear rate with by workers with 5 years or less of experience holding almost 50% of all CE-level 1 certificates. Again, the CE-level indicted in the figure is the maximum held, meaning that if the analyst indicated a level 2 certificate then it is assumed the worker maintains a level 1, but the level 1 certificate is not indicated in the figure above. The percentage of level 3 certificates does not follow the expected path. However, with only six total certificates; one certificate represents almost 17% of the total.

### **Supervisor Feedback**

As previously stated, approximately 20 supervisors completed the questionnaire. These 20 supervisors indicated that they supervise a total of 109 civilians, 13 military, and 59 contractors. The questionnaire for the supervisors includes some qualitative questions seeking to identify any universal problems or opportunities. All totaled, the supervisors indicated they assisted in 224 different programs broken out as 42 acquisition category I (ACAT I), 27 ACAT II and 171 non-ACAT I/II programs.

Over 73% of the supervisors indicated that they did not have sufficient numbers of analysts to complete the required workload. Additionally, while not explicitly asked, three supervisors indicated their office works considerable overtime in order to meet program goals. Of those supervisors indicating they did

have sufficient work force, four out of the five indicated their workforce lacked experience. All totaled, 82% of the supervisors mentioned at least once that experience in cost analysis was lacking. In addition to the lack of experience, 63% indicated their team did not have a sufficient level of technical competence. Of the respondents, 75% indicate sacrificing tasks in order to maintain current production levels.

When questioned specifically on aspects of WSARA, supervisors answered in a largely positive way with 79% feeling that WSARA addresses some of the deficiencies in the cost community. The general feeling was that WSARA placed increased pressure on decision makers to utilize the cost estimates created by the organizations. A few supervisors did indicate that while largely positive in its effects, WSARA was detrimental to the organization. One supervisor who indicated that the office needed more individuals prior to the WSARA implementation stated that the new requirements created an even greater need for increased work force. Compounding the effect of raw manning number, hiring difficulties and personnel turnover create a need for training and result in knowledge drain. While hiring over 69 individuals during the preceding 24 months of the study, the majority of the respondents (94%) indicated hiring new analysts as difficult, with 50% indicating hiring as extremely difficult. Many respondents specified recently filling a few personnel billets, however, many remained unfilled.

## **Preliminary analysis**

The purpose of preliminary analysis is to perform a confirmatory analysis of the individual measures and construct the four-factor measure of virtualness. As identified earlier, current literature lacks a commonly accepted measure for virtualness and as such, this paper seeks to partially address this point. The findings will highlight that significant correlations between various items indicate that the questionnaire exhibits required power.

### **Initial virtualness measure creation**

The questionnaire contains 41 individual questions addressing the four dimensions of virtualness. Preliminary analysis of these items indicates that a 40-question measure failed to achieve specificity. In order to identify the strongest measures, I first performed a factor analysis within each dimension of virtualness. Seeking to create a 16-question measure for virtualness, I identified the four strongest measures within each dimension. Table 10 below summarizes the strongest four items in each dimension of virtualness. After identifying the four questions in each dimension, I conducted reliability analyses on the items.

**Table 10: Confirmatory Factor Analysis – Initial 16item Measure for Virtualness**

Virtualness Factor Analysis - 16 item measure (preliminary)			
Technical Support		Synchronicity	
	Initial Eigenvalue		Initial Eigenvalue
Technical Support 4	0.848	Synchronicity 9	0.846
Technical Support 3	0.793	Synchronicity 2	0.834
Technical Support 10	0.668	Synchronicity 8	0.820
Technical Support 7	0.470	Synchronicity 6	0.768
Richness of Technology		Distance	
	Initial Eigenvalue		Initial Eigenvalue
Tech Richness 7	0.788	Distance 9	0.902
Tech Richness 10	0.749	Distance 8	0.890
Tech Richness 5	0.734	Distance 1	0.872
Tech Richness 1	0.687	Distance 6	0.660

\* Extraction Method: Principal Component Analysis

Table 11 below summarizes the reliability statistics. The commonly accepted threshold for reliability is greater than 0.70 Cronbach's alpha. As the table indicates, the preliminary analysis for three of the four measures exceeds the desired 0.70. However, the reliability of reliance on technical support is low. Item 7 of technical support exhibits a mediocre relation to the other questions, resulting in a low Eigenvalue. Technical support item 7 may be starting to measure a secondary factor of technical support that the other three questions do not. Additionally, while the sample size is statistically significant, the weak Cronbach's alpha may be in part due to the relatively small sample size.

**Table 11: Reliability statistics – Initial 16 item measure for virtualness**

Virtualness reliability statistics - 16 item measure (preliminary)	
	Cronbach's Alpha
Distance	0.853
Technical Support	0.670
Richness of Technology	0.709
Synchronicity	0.834

### **Structural Equation Modeling**

Having identified the four items within the four dimensions that I would utilize to construct the measure for virtualness, I proceeded to complete a structural equation model (SEM) to verify the applicability of the measure. Structural equation modeling consists of three primary processes: path analysis, confirmatory factor analysis, and structural regression models all comprise aspects of the SEM. SEM is excellent at validating that data fit a given model; however, SEM is not an exploratory technique used to create a model. Given that I had arrived at a preliminary model, which used four questions in each of the four dimensions of virtualness, I leveraged SEM to verify the applicability of the model.

When implementing SEM to analyze the 16 measures for virtualness, I had to acknowledge that while each dimension is separate, some overlap might exist. While the face validity of a question on distance may indicate a single factor, the dimension of distance may affect or be affected by the level of synchronicity. After addressing the possibility for interdependence of the measures, I ran a model fit analysis. The preliminary 16-question measure for virtualness proved acceptable. The relative chi-square, which is chi-square divided by the degrees of freedom, resulted in 1.606. The incremental fit index (IFI) of 0.917 for the 16-item measure

exceeded the common threshold of 0.9. The comparative fit index (CFI) of 0.913 surpassed the desired 0.9 figure. However, the root mean square error of approximation (RMSEA) for the measure resulted in a marginal fit of 0.076 while a desired fit is near 0.05.

### **Final Analysis – Virtualness measure**

Preliminary analysis of the SEM output indicated that the measure needed improvement. The acceptable relative chi-square of 1.606 and the marginal RMSEA of 0.076 highlighted the need for more refinement of the measure for virtualness. In order to improve model fit, I reduced the number of items per factor from four to three. Rerunning the proper confirmatory factor analysis and reliability tests allowed for an overall reduction in items from 16 to 13. Table 12 below summarizes the confirmatory factor analysis for the final 13-item measure of virtualness. The initial Eigenvalues for the individual items generally improved when moving from the 16-item to the 13-item measure.



**Table 12: Confirmatory Factor Analysis – Final 13 item Measure for Virtualness**

Virtualness factor analysis – 13-item measure (final)			
Technical Support		Synchronicity	
	Initial Eigenvalue		Initial Eigenvalue
Technical Support 4	0.879	Synchronicity 9	0.855
Technical Support 3	0.793	Synchronicity 2	0.850
Technical Support 10	0.698	Synchronicity 8	0.862
Richness of Technology		Distance	
	Initial Eigenvalue		Initial Eigenvalue
Tech Richness 7	0.788	Distance 9	0.932
Tech Richness 10	0.749	Distance 8	0.855
Tech Richness 5	0.734	Distance 1	0.904
Tech Richness 1	0.687		

\* Extraction Method: Principal Component Analysis

The goal of reducing the items from 16 to 12 was not achievable due to reliability concern. All dimensions except for richness of technology exceeded the 0.7 threshold for Cronbach's Alpha after reducing the number of items per measure from four to three. Richness of technology required four items in order to keep the Cronbach's Alpha above 0.7. Table 13 below summarizes the reliability statistics for the final 13-item measure of virtualness.

**Table 13: Reliability Statistics – Final 13 item Measure for Virtualness**

Virtualness reliability statistics - 13 item measure (final)	
	Cronbach's Alpha
Distance	0.889
Technical Support	0.705
Richness of Technology	0.709
Synchronicity	0.816

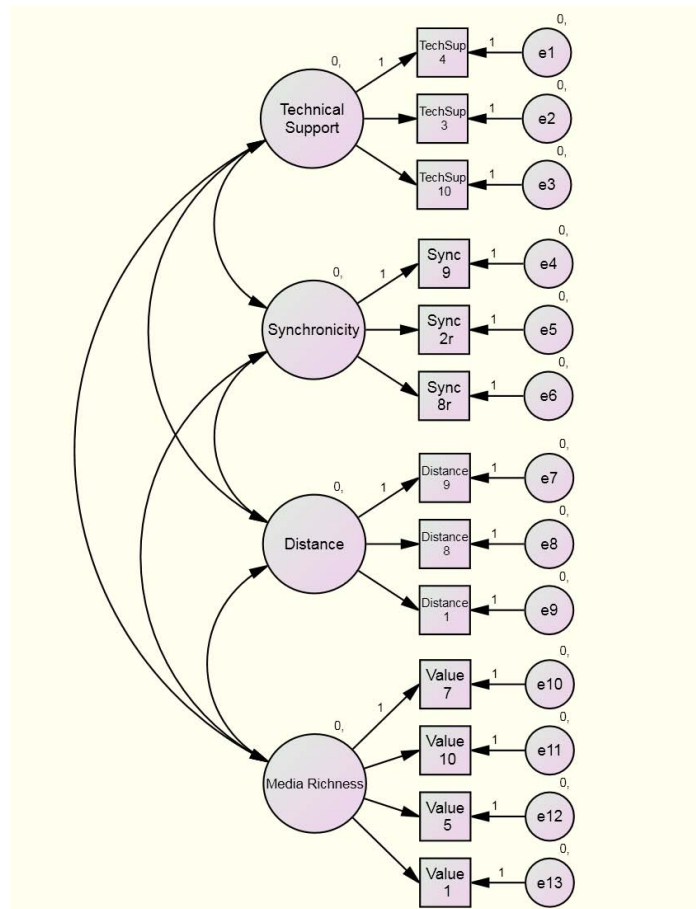
While the 13-item measure meets all desired statistics, having an uneven number of items for the individual dimensions creates an aggregation problem.

Aggregating items individually into a single “virtualness” item creates a disproportional weighting with Value weighing more heavily in the resulting level of virtualness. In order to avoid this problem of weighting, I first aggregated the items into the respective dimension. I then aggregated the resulting four dimensions of virtualness into a single measure for virtualness. The aggregated measure follows the Likert-type scale with 1 being low virtualness and 5 being highly virtual. A result of “highly virtual” is similar to a very disruptive environment. For analysis purposes, I reverse-coded the virtual measure due to the idea that a highly virtual measure should negatively correlate to the other measures in the questionnaire.

**Table 14: Final 13 item Measure for Virtualness**

<b>Distance</b>
1. My supervisor thoroughly understands my working environment.
2. My supervisor and I have a common understanding of work requirements.
3. My supervisor understands the daily requirements of my job.
<b>Technical Support</b>
1. My supervisor carries a cell phone.
2. My supervisor is available on a cell phone throughout the workday.
3. I utilize information technology in my daily interactions with my supervisor.
<b>Richness of Technology</b>
1. I am easily able to understand the message from my supervisor.
2. I am easily able to understand a variety of different cues (e.g. emotional tone, feelings) from my supervisor.
3. I am easily able to tailor my messages to my supervisor.
4. I am able to use rich and varied language when communicating with my supervisor.
<b>Synchronicity</b>
1. It is often difficult to get in touch with my supervisor.
2. My supervisor and I have difficulties aligning our schedules.
3. My supervisor is available whenever I need him/her.

After identifying the 13-item measure and aggregating the data, I utilized SEM a second time to test model fit. The new 13-item measure proved much better in all tests. The relative chi-square improved from 1.606 to 1.303. The IFI and CFI improved as well from 0.917 to 0.969 and from 0.913 to 0.967 respectively. The final hurdle of RMSEA proved to solidify the improved measure, falling from 0.076 to 0.053. Figure 16 below shows the final 13-item measure as tested in SEM for model fit.



**Figure 16: 13-item Measure for Virtualness (final) Amos SEM**

## Hypotheses testing

As previously mentioned, over 300 electronic invitations were sent with an approximate response rate of 34%. All measures contained over 100 responses. Table 15 below shows the descriptive information for the calculated values. As example, the measure for job satisfaction uses four questions. Averaging the responses for the four questions into an overall Likert-type scale creates a value per individual.

**Table 15: Descriptive Statistics**

Descriptive Statistics					
	N	Min	Max	Mean	Std. Dev
Jobsat	102	1.00	5.00	3.96	0.82
LMX	103	1.00	5.00	3.87	0.86
Org Commit	102	1.00	4.75	3.29	0.72
Trust	105	1.29	4.71	3.50	0.64
Turnover Intention	102	1.00	5.00	2.11	0.95
Virtualness	102	1.06	3.31	2.12	0.50

Table 16 below summarizes the correlations between the measures. All measures indicate a strong correlation with virtualness. The matrix highlights the relationship between the variables measured in the questionnaire. As expected, turnover intention negatively correlates with all measures except virtualness. Virtualness exhibits similar correlations with the other measures in that it negatively correlates. The negative correlation indicates that as virtualness increases, job satisfaction, LMX, and organizational commitment decrease.

**Table 16: Pearson Correlation Matrix**

<b>Correlations</b>						
	Trust	Job sat	LMX	Turn Int	Org Commit	Virtualness
Trust	(.73)					
Job Satisfaction	.55**	(.85)				
Leader-Member Exchange	.78**	.56**	(.95)			
Turnover Intention	-.50**	-.82**	-.47**	(.64)		
Organizational Commitment	.57**	.71**	.51**	-.76**	(.87)	
Virtualness	-.67**	-.57**	-.78**	.44**	-.49**	(.79)

Reliabilities appear in parentheses along the diagonal

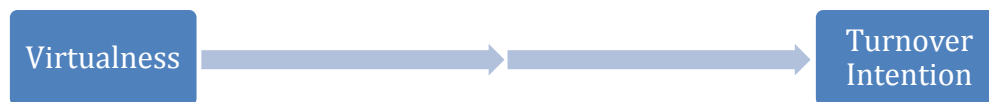
\*\* . Correlation is significant at the 0.01 level (2-tailed).

Table 17 below summarizes the results of multiple regression analyses. In order to test hypotheses 1-4, the independent variable, virtualness, was regressed against the dependent variable. In each case, the regression consisted of one independent and one dependent variable. All hypotheses proved significant and exhibited a medium effect size on the dependent variable. The effect size for the relationship between virtualness and trust tested more significant than expected. For hypotheses 5-7, the independent variable differed during each regression while testing against the singular dependent variable of turnover intention. Again, all indications tested as expected. The effect sizes for job satisfaction and organizational commitment in relation to turnover intention regressed more strongly than expected.

**Table 17: Multiple Regression Analysis for Hypothesis Testing**

Regression Analysis of Hypotheses								
Hypothesis	Variable		Standardized		R <sup>2</sup>	Adj. R <sup>2</sup>	t-value	Sig.
	Independent	Dependent	$\beta$	SE $\beta$				
1	Virtualness	Trust	-0.67	0.10	0.45	0.45	-9.11	0.00
2		Job Satisfaction	-0.57	0.13	0.32	0.32	-6.89	0.00
3		Org Commit	-0.49	0.13	0.24	0.23	-5.59	0.00
4		Turnover Intention	0.44	0.17	0.20	0.19	4.94	0.00
Hypothesis	Variable		Standardized		R <sup>2</sup>	Adj. R <sup>2</sup>	t-value	Sig.
	Independent	Dependent	$\beta$	SE $\beta$				
5	Trust	Turnover	-0.50	0.13	0.25	0.24	-5.71	0.00
6	Job Sat	intention	-0.82	0.07	0.67	0.67	-14.27	0.00
7	Org Commit		-0.76	0.09	0.58	0.57	-11.70	0.00

Testing mediation effects of the variables required a three-step process (Frazier, Tix, & Barron, 2004). First, the independent variable of virtualness was regressed against the dependent variable turnover intention. Figure 17 below diagrams the tested regression for Hypothesis 8. The results of Step 1 are included in Table 17 above. The need to complete Step 1 originated from the need to identify if any relationship existed for which the mediator might affect. If Step 1 returned values of no significance or no effect size, then the need to test mediation was moot.



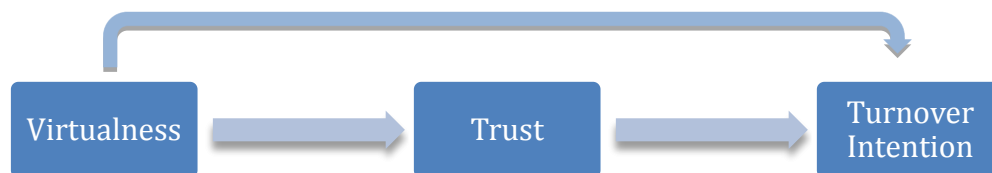
**Figure 17: Step 1 Mediation testing**

Step 2 of the mediation testing process involved regressing the independent variable against the proposed mediator. Step 2 was critical to establish a relationship between the independent variable and the proposed mediator. Figure 18 below diagrams the process of regressing virtualness against trust for Hypothesis 8. Again, the results of step two are included in Table 17 above.



**Figure 18: Step 2 Mediation testing**

The third step involved regressing the independent variables against the dependent variable. For Hypothesis 8, the regression analysis included independent variables virtualness and trust against the dependent variable turnover intention. Figure 19 below diagrams the relations tested in the multiple regression analysis. Comparing the regression analysis completed in Test 3 against the previous tests helps to identify any effects of mediation.



**Figure 19: Step 3 Mediation testing**

Frazier et al. (2004) indicate that in order for the mediation of the independent variable's relation with the dependent variable, the Beta ( $\beta$ ) of the

independent variable must be zero in the multiple regression analysis. Stated differently, the reduction of  $\beta$  from the determined  $\beta$  of Step 1 to zero in Step 3 indicates a complete mediation of the relationship between the independent and dependent variables. Table 18 below summarizes the regressions performed to complete Step 3. None of the  $\beta$  associated with virtualness in hypotheses 8-10 reduced to zero when introducing a mediator. Standardizing all  $\beta$  ensures proper basis for comparison. However, when comparing the  $\beta$  for virtualness in Step 3 against the corresponding Step 1  $\beta$ , all  $\beta$  decreased. Given that none of the  $\beta$  reduced to zero, the testing for mediation requires additional inspection.

**Table 18: Multiple Regression analysis for mediation testing**

Results of multiple regression analysis									
Hypothesis	Variable		Standardized		$R^2$	Adj. $R^2$	t-value	Sig.	Test for Mediation
	Independent	Dependent	$\beta$	SE $\beta$					
8	Trust *	Turnover	-0.36	0.17	0.27	0.25	-3.10	0.00	2.00
	Virtualness	Intention	0.20	0.22			1.72	0.09	
9	Job Sat *	Turnover	-0.84	0.08	0.67	0.67	-11.96	0.00	3.92
	Virtualness	Intention	-0.03	0.13			-0.45	0.65	
10	Org Commit *	Turnover	-0.71	0.10	0.59	0.58	-9.62	0.00	3.42
	Virtualness	Intention	0.10	0.14			1.28	0.20	

The procedure for determining mediation, given that  $\beta$  was not zero, involved using the information derived in Steps 2 and 3. To complete the equation below, the variable “a” corresponds to the  $\beta$  of Step 2.

**Equation 1: Testing for mediation (Kenny, Kashy, & Bolger, 1998)**

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The  $b$  in the equation equals the  $\beta$  found in Step 3 relating to the proposed mediator and the dependent variable. The equation below includes the standard error for each corresponding relationship. The resulting  $z$  value allowed for statistical significance testing, in this case a 95% confidence interval. Table 18 above includes the results of the mediation test for each of the hypotheses. In all cases, the values exceeded the required value of 1.96, indicating the mediation was significant. The results of the test indicated that the data supports hypotheses 8-10.

## **V. Conclusion and Recommendations**

The primary goal of the questionnaire was threefold. First, the questionnaire sought to identify the areas of cost estimating currently requiring the greatest amount of time within the community. Second, I sought to identify any differences from the previous snapshot in time summarized in the RAND study. Third, I sought to develop a reliable measure for virtualness and to use this measure with hopes of highlighting areas for improvement or strengths currently exhibited in the cost community.

The questionnaire succeeded in identifying the average time use for cost estimators. As shown in Table 4 above, the four largest areas of time utilization for cost estimators are consulting with the PM, preparing initial estimates, reviewing estimates, and meetings. A secondary result of the questionnaire raises concern about the actual understanding of time use between supervisors and subordinates. The large variation between expectations of the supervisor and stated workload of the subordinate seems to show a substantial disconnect. The largest disparity exists between supervisors and military subordinates. Some of the comments of the supervisors may explain this disparity, as one supervisor wrote, "The military are never here more than 2 years total time in the branch, and during that 2-year period, they all must deploy for 180 days. Add on the two months of pre-deployment training and the two months of post-deployment re-orientation and leave, and they are pretty much useless to the...mission." If representative, the statement indicates the frustrations felt by the supervisors towards the military

operations tempo and, as a result, supervisors take a more hands-off approach to the management of military personnel.

A second area of concern surrounding the time usage as reported by the respondents is in the area of EVM. Using EVM data and analyzing EV data accounts for less than 10% total time within each personnel category. Given the current focus on accurate cost estimates and management controls, the respondents spend very little time reviewing program performance. WSARA stresses the importance of accurate cost estimates with the goal of more stringent program control. In reality, no matter how accurate the cost estimate, improper control and management of the program strike even the best cost estimates useless.

The second area of focus for the questionnaire is its comparison against the RAND data. When comparing the personnel numbers surrounding experience, the recent results seem positive. The percentage of personnel with less than five years of experience has decreased compared to other categories. Additionally, the area of 5 to 20 years of experience has grown in percentage. While these figures bode well for the community, supervisors report that the growth is not sufficient when compared to demand: "Absolutely we do not have enough analysts," "We are short about 18 people." "I need at least one additional analyst per program," are just a few of the comments from supervisors when asked whether they had enough cost analysts to meet the program demand.

The situation grows drearier when respondents report on experience: "We have much to learn; three fourths of our staff are neophytes," "Our staff has either

over 10 years...or less than 2," "too inexperienced," "75% of my staff has three years' experience or less; 50% of my staff is within their first year." These statements are just a snippet of the unrest within the community regarding experience and workforce. While WSARA and other recent policies stress the importance of revitalizing the acquisition community, many areas experience difficulty filling empty billets. While I previously discussed the recent hiring in personnel, the supervisors reported 37 people leaving the cost community during the same period. The net result of 32 new individuals seems to correspond with some of the above statements about inexperienced staff.

Additionally, while the 5-20 years of experience group grew as percentage, the over-20 group remained largely unchanged. This could indicate that retention in the mid-grade pay ranges is good, while the upper band is unchanged. A statement I heard multiple times was that it takes at least six years of cost estimating to become proficient. As such, the cost analysis field considers personnel with less than 10 years as junior or inexperienced. The report shows that 70% of the cost estimating community has 10 years or less of experience. Seasoned or senior analysts comprise only 30% of the field when using number of years as a proxy for experience and ability.

Third, the questionnaire sought to develop a measure for virtualness. The literature surrounding virtualness differs upon whether three or four dimensions of virtualness are required for an accurate measure. This study argues that physical distance is too limiting in its relation to virtualness and, as such, a more accurate

determinate is psychological distance. Virtualness can be likened to discontinuities, and so the more virtual an organization, team, or relationship, the more discontinuous the relations. Psychological distance amplifies the discontinuity between individuals and is tangentially necessary to virtualness. The 41-item measure significantly reduced to a valid, reliable 13-item questionnaire.

### **Limitations**

While the available sample set allowed for sufficient data to create a statistically significant report, a larger population would allow for a more thorough analysis. In addition to the smaller population of the cost estimating community within the Air Force, a non-military or government-related population would ensure applicability in civilian businesses. While the measure for virtualness satisfied all confirmatory requirements for reliability and model fit, a second sample to verify the measure was not applicable due to time constraints. As such, an independent verification of the measure would boost the acceptance of the measure.

The comparison between the RAND data and my questionnaire also warrants comments on limitations. The data gathered in both instances are samples of the total population. As such, there are to be expected variances between the samples. Natural sample variance might explain the increase in experience observed in the 2010 questionnaire, resulting in essentially the same levels of experience between the two samples. However, dismissing the observed increase in middle level experience merely due to variance ignores the plausibility of typical maturation. Over a two-year time lapse occurred between the 2010 questionnaire and the RAND

study. Normal experience growth should occur during the two years subsequent the RAND study. Additionally, the external factors such as the weakened economy might push individuals to remain in government service work longer than typical. The economy is just but one factor that might contribute to a greater retention rate that would cause an increase in experience. Decision makers must apply the proper retention tools to ensure adequate growth and maintain the current experience observed throughout the cost estimating community.

### **Further Research**

As mentioned in the limitations section, an independent verification of the model would ensure reliability. Subsequent studies potentially improve the measure through refinement and validation. Additionally, utilizing the model to verify antecedents and outcomes previously studied in literature would strongly support the validity of the 13-item measure for virtualness.

While sampling as a data gathering method is a limitation of this research, further samplings might verify the findings within the cost community. The RAND study and this research create two snapshots in time of the cost community. A greater number of studies would allow for a greater understanding of the community and its allocation of resources.

A second possibility for further research is developing the proper allocation of time for the cost estimating community. The questionnaire gathered information as to the current allocation of time, but did not develop a recommendation for

proper time allocation. One might use the Delphi technique to define a generic template for cost analysts to model as the recommended allocation of time.

Lastly, using the measure of virtualness created and sampling other communities is an excellent area of further research. Expanding the research into other Air Force communities (such as maintenance or intelligence), allows for the identification of any cost community specific differences that complicate the implementation of acquisition reform. Ultimately, the goal should be to develop a greater understanding of the entire DoD. Decision makers might use this information to structure policies that overcome the limitations of virtualness and effectively improve overall implementation.

## Appendix A. List of Acronyms

ACAT	Acquisition Category
AF	Air Force
AFCAA	Air Force Cost Analysis Agency
AFMC	Air Force Material Command
AFSPC	Air Force Space Command
AIP	Acquisition Improvement Plan
APDP	Acquisition Professional Development Program
CCEA	Certified Cost Estimator/Analyst
CDFM	Certified Defense Financial Management
DoD	Department of Defense
EVM	Earned Value Management
FASA	Federal Acquisition Streamlining Act of 1994
FFRDC	Federally Funded Research and Development Centers
GPRA	Government Performance and Results Act of 1993
LAAFB	Los Angeles Air Force Base
MAJCOM	Major Command
MDAP	Major Defense Acquisition Program
OSD	Office of Secretary of Defense
PEO	Program Executive Officer
SAR	Selected Acquisition Report
WSARA	Weapon Systems Acquisition Reform Act of 2009



## Appendix B. Descriptive Statistics

Descriptive Statistics									
	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
						Statistic	Std. Error	Statistic	Std. Error
Jobsat	102	1.00	5.00	3.96	0.82	-0.96	0.24	1.03	0.47
LMX	103	1.00	5.00	3.87	0.86	-1.26	0.24	1.62	0.47
Org Commit	102	1.00	4.75	3.29	0.72	-0.61	0.24	0.59	0.47
Trust	105	1.29	4.71	3.50	0.64	-0.76	0.24	1.21	0.47
Turnover Intention	102	1.00	5.00	2.11	0.95	0.94	0.24	0.33	0.47
Virtualness	102	1.06	3.31	2.12	0.50	0.50	0.24	-0.11	0.47

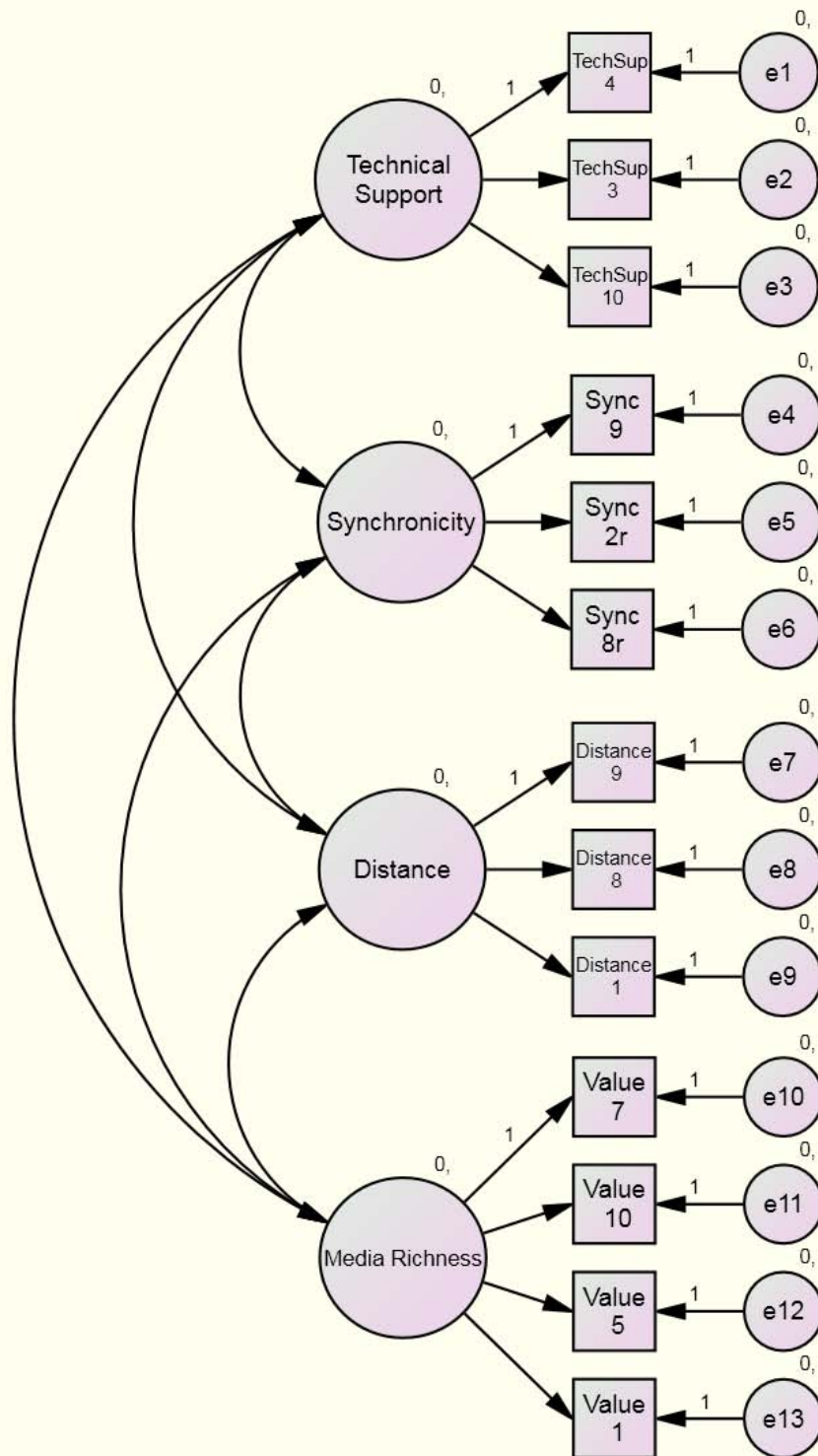
Reliabilities	
Trust	(.73)
Job Satisfaction	(.85)
Leader-Member Exchange	(.95)
Turnover Intention	(.64)
Organizational Commitment	(.87)
Virtualness	(.79)

Correlations							
		Trust	Jobsat	LMX	TurnInt	OrgCommit	Virtualness Final
Trust	Pearson Correlation	1					
	Sig. (2-tailed)						
	N	105					
Jobsat	Pearson Correlation	.554**	1				
	Sig. (2-tailed)	0					
	N	102	102				
LMX	Pearson Correlation	.777**	.568**	1			
	Sig. (2-tailed)	0	0				
	N	103	102	103			
TurnInt	Pearson Correlation	-.496**	-.819**	-.470**	1		
	Sig. (2-tailed)	0	0	0			
	N	102	102	102	102		
OrgCommit	Pearson Correlation	.556**	.709**	.513**	-.760**	1	
	Sig. (2-tailed)	0	0	0	0		
	N	102	102	102	102	102	
VirtualnessFinal	Pearson Correlation	-.673**	-.567**	-.747**	.443**	-.488**	1
	Sig. (2-tailed)	0	0	0	0	0	
	N	102	102	102	102	102	102

Regression Analysis of Hypotheses								
Hypothesis	Variable		Standardized		R <sup>2</sup>	Adj. R <sup>2</sup>	t-value	Sig.
	Independent	Dependent	$\beta$	SE $\beta$				
1	Virtualness	Trust	-0.67	0.10	0.45	0.45	-9.11	0.00
2		Job Satisfaction	-0.57	0.13	0.32	0.32	-6.89	0.00
3		Org Commit	-0.49	0.13	0.24	0.23	-5.59	0.00
4		Turnover Intention	0.44	0.17	0.20	0.19	4.94	0.00
Hypothesis	Variable		Standardized		R <sup>2</sup>	Adj. R <sup>2</sup>	t-value	Sig.
	Independent	Dependent	$\beta$	SE $\beta$				
5	Trust	Turnover	-0.50	0.13	0.25	0.24	-5.71	0.00
6	Job Sat	intention	-0.82	0.07	0.67	0.67	-14.27	0.00
7	Org Commit		-0.76	0.09	0.58	0.57	-11.70	0.00

Results of multiple regression analysis									
Hypothesis	Variable		Standardized		R <sup>2</sup>	Adj. R <sup>2</sup>	t-value	Sig.	Test for Mediation
	Independent	Dependent	$\beta$	SE $\beta$					
8	Trust *	Turnover	-0.36	0.17	0.27	0.25	-3.10	0.00	2.00
	Virtualness	Intention	0.20	0.22			1.72	0.09	
9	Job Sat *	Turnover	-0.84	0.08	0.67	0.67	-11.96	0.00	3.92
	Virtualness	Intention	-0.03	0.13			-0.45	0.65	
10	Org Commit *	Turnover	-0.71	0.10	0.59	0.58	-9.62	0.00	3.42
	Virtualness	Intention	0.10	0.14			1.28	0.20	

## Appendix C. Amos Output – Structural Equation Model



**Parameter Summary (Group Number 1)**

	Weights	Covariances	Variances	Means	Intercepts	Total
Fixed	17	0	0	0	0	17
Labeled	0	0	0	0	0	0
Unlabeled	9	6	17	0	13	45
Total	26	6	17	0	13	62

**Result (Default Model)**

Minimum was achieved

Chi-square = 76.885

Degrees of freedom = 59

Probability level = .059

**Model Fit Summary****CMIN**

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	45	76.885	59	.059	1.303
Saturated model	104	.000	0		
Independence model	13	633.723	91	.000	6.964

**Baseline Comparisons**

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.879	.813	.969	.949	.967
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

**Parsimony-Adjusted Measures**

Model	PRATIO	PNFI	PCFI
Default model	.648	.570	.627
Saturated model	.000	.000	.000
Independence model	1.000	.000	.000

**NCP**

Model	NCP	LO 90	HI 90
Default model	17.885	.000	44.659
Saturated model	.000	.000	.000
Independence model	542.723	466.638	626.289

**FMIN**

Model	FMIN	F0	LO 90	HI 90
Default model	.725	.169	.000	.421
Saturated model	.000	.000	.000	.000
Independence model	5.979	5.120	4.402	5.908

**RMSEA**

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.053	.000	.085	.411
Independence model	.237	.220	.255	.000

**AIC**

Model	AIC	BCC	BIC	CAIC
Default model	166.885	180.580		
Saturated model	208.000	239.652		
Independence model	659.723	663.679		

**ECVI**

Model	ECVI	LO 90	HI 90	MECVI
Default model	1.574	1.406	1.827	1.704
Saturated model	1.962	1.962	1.962	2.261
Independence model	6.224	5.506	7.012	6.261

**HOELTER**

Model	HOELTER .05	HOELTER .01
Default model	108	121
Independence model	20	21

## Appendix D. Questionnaire

### Cost Community Questionnaire

The following questions pertain to your current job. Read each statement and answer to the best of your ability.

1. Are you currently supervising government civilians or military?
2. Total years of cost analysis experience (Count all years of cost analysis work with at least 50% effort towards cost).
3. Total years of other FM experience (Count all years employed in FM work at least 50% of the time, including cost estimating and analysis).
4. Total % time spent in acquisition cost estimating during past six months.

### Non-Supervisors

Within the last 6 months, what % Time spent on following activities:		% Time
a.	% time spent analyzing Earned Value Management (EVM) data (i.e. CPR, CSSR) using winsight or other program in support of program management	
b.	% time spent using Earned Value (EV) data in support of creating estimates	
c.	% time spent doing non-cost related financial management	
d.	% time spent managing support contractors	
e.	% time consulting with PM or personnel in other departments to discuss and formulate estimates or resolve issues	
f.	% time preparing initial estimates	
g.	% time reconciling estimates with either AFCAA or OSD	
h.	% time reviewing estimates	
i.	% time completing post estimate documentation	
j.	% time completing what-if drills for PM due to program changes or budget	
k.	% time spent in meetings	
l.	% time training (relating to cost only: included both time spent in training and time spent training others)	
m.	% time spent in non-cost related training (annual training – Information Protection, Human Trafficking, etc; do not include time spent doing cost related	
n.	% time Other _____	
<b>Total: Must add up to 100%</b>		<b>0%</b>

5. You indicated you spent \_\_% time completing what-if drills. Please elaborate on the reasons for these drills. Examples of reasons for what-if drills include identifying potential efficiencies or quantifying the impact of budget changes.

**\*Trust Items (Schoorman & Ballinger, 2006)**

Read each statement and, using the scale below as reference, mark the number ranging from 1 “strongly disagree” to 5 “strongly agree” which indicates how you feel.

---

1 = Strongly Disagree	2 = Disagree	3 = Neither	4 = Agree	5 = Strongly Agree
-----------------------	--------------	-------------	-----------	--------------------

---

Think about your current supervisor. The items below ask about your relationship with, and thoughts about this particular individual.

- 42. My supervisor keeps my interests in mind when making decisions.
- 43. I would be willing to let my supervisor have complete control over my future in this organization.
- 44. If my supervisor asked why a problem occurred, I would speak freely even if I were partly to blame.
- 45. I feel comfortable being creative because my supervisor understands that sometimes creative solutions do not work.
- 46. It is important for me to have a good way to keep an eye on my supervisor.
- 47. Increasing my vulnerability to criticism by my supervisor would be a mistake.
- 48. If I had my way, I wouldn't let my supervisor have any influence over decisions that are important to me.

**\*Leadership Member Exchange (Revised – Liden, Wayne, & Stillwell, 1993)**

- 49. I know where I stand with my supervisor.
- 50. I usually know how satisfied my supervisor is with me.
- 51. My supervisor understands my job problems and needs.
- 52. My supervisor recognizes my potential.
- 53. My supervisor would use his/her power to help me solve work related problems.
- 54. My supervisor would “bail me out” at his/her own expense.
- 55. I defend and justify my supervisor's decisions when he/she is not present to do so.
- 56. I have an effective working relationship with my supervisor.

**\*Job Satisfaction**

Read each statement and, using the scale below as reference, mark the number ranging from 1 “strongly disagree” to 5 “strongly agree” which indicates how you feel.

---

1 = Strongly Disagree	2 = Disagree	3 = Neither	4 = Agree	5 = Strongly Agree
-----------------------	--------------	-------------	-----------	--------------------

---

Think about your current employment. The items below ask about your thoughts about this particular employment.

- 57. All in all, I am satisfied with my job.
- 58. In general, I don't like my job.
- 59. In general, I like working here.
- 60. I frequently think of quitting this job.

**\*Turnover Intentions**

- 61. I am actively looking for a job outside.
- 62. As soon as I can find a better job, I'll leave this organization.
- 63. I am seriously thinking about quitting my job.
- 64. I often think about quitting my job at this organization.
- 65. I think I will be working at this organization five years from now.

**Organizational Commitment - affective (Meyer & Allen, 1997)**

- 66. I would be happy to spend the rest of my career with this organization.
- 67. I enjoy discussing my organization with people outside it.
- 68. I really feel as if this organization's problems are my own.
- 69. I think that I could easily become as attached to another organization as I am to this one.
- 70. I do not feel like "part of the family" at my organization.
- 71. I do not feel emotionally attached to this organization.
- 72. This organization has a great deal of personal meaning for me.
- 73. I do not feel a strong sense of belonging to my organization.

**Virtualness (Adapted from Carlson & Zmud 1999)**

Read each statement and, using the scale below as reference, mark the number ranging from 1 "strongly disagree" to 5 "strongly agree" which indicates how you feel.

---

1 = Strongly Disagree	2 = Disagree	3 = Neither	4 = Agree	5 = Strongly Agree
-----------------------	--------------	-------------	-----------	--------------------

---

Think about your current supervisor. The items below ask about your relationship with and thoughts about this particular individual.

**Distance**

- 74. My supervisor thoroughly understands my working environment.
- 75. My supervisor works within close physical proximity to me.
- 76. My team members understand my job requirements.
- 77. I really understand why people behave the way they do in my organization.
- 78. I often interact with team members not co-located with me.



- 79. I have a good understanding of the environment in which my organization operates.
- 80. Time zones add difficulty to my work.
- 81. My supervisor understands the daily requirements of my job.
- 82. My supervisor and I have a common understanding of work requirements.
- 83. I have a good sense of the dynamics within my organization.
- 84. I know what other people in my organization are doing.

### **Technical Support**

- 85. My supervisor carries an email-enabled smartphone such as a Blackberry™.
- 86. I am unable to communicate with my team/supervisor without electronics: telephone, computer, etc.
- 87. My supervisor is available by cell phone throughout the workday.
- 88. I primarily communicate with my team members through email.
- 89. I use email to communicate with my supervisor.
- 90. I primarily complete my work through computers.
- 91. I contact my supervisor through telephone conversations.
- 92. Without computers, I would be unable to accomplish my job.
- 93. I utilize information technology in my daily interactions with my supervisor.
- 94. My supervisor carries a cell phone.

### **Media Richness**

- 95. I often speak in person with my supervisor to clarify messages received through electronic formats.
- 96. Utilizing email makes it difficult to understand the tone of messages from my supervisor.
- 97. I am easily able to understand a variety of different cues (e.g., emotional tone, feelings) from my supervisor.
- 98. I often seek instructions sent via email from my supervisor regarding work requirements.
- 99. I am easily able to understand the message from my supervisor.
- 100. I am easily able to tailor my messages to my supervisor.
- 101. I often speak in person with my coworkers to clarify messages received through electronic formats.
- 102. I am able to use rich and varied language when communicating with my supervisor.
- 103. It is easy to exchange timely feedback with my supervisor.
- 104. I am easily able to maintain multiple conversations with co-workers/supervisors.

### **Synchronicity**

- 105. It negatively affects my work when my supervisor is absent.
- 106. My supervisor is available whenever I need him/her.
- 107. My supervisor's work schedule is in-sync with my own work schedule.

- 108. My supervisor answers my questions on the same day I send the email.
- 109. It is often difficult to get in touch with my supervisor.
- 110. My supervisor and I often have misunderstandings driven by the differences in our schedules.
- 111. My supervisor and I have difficulties aligning our schedules.
- 112. My schedule changes based on my supervisor's schedule.
- 113. My supervisor and I always seem to be in tune as to what we are doing.
- 114. My supervisor responds to my messages (e.g., phone, email) in a timely manner.

**115. Demographics**

- 116. AF Organization/ Office symbol:
- 117. ACAT Program(s) worked on during past 6 months:
- 118. Status: Full-time, Part-time
- 119. Current Mil Grade or Civilian Pay Plan-Series-Grade:
- 120. How far away in miles are you located from your supervisor?
- 121. Name of supervisor:
- 122. Duty AFSC:
- 123. ADPD Certification type and level:
- 124. Financial certificates: CDFM, CDFM-A, CPA, CCEA, other
- 125. Duty title:
- 126. Full name:

## **Supervisors**

1. How many acquisition programs and what category do you currently manage?
2. Explain whether you have enough cost analysts to effectively support your team's portfolio of ACAT programs. Include the number of extra or needed analysts and what programs they will support.
  - a. Explain any tasks that are being sacrificed in order to accomplish the mission.
  - b. Explain any tasks that are being completed that do not contribute to the mission.
3. How many cost estimators, over how many months, does it take to perform a thorough estimate of the cost of a \$500-million new program?
4. Is there a disparity between what your team is presently working on and what you prefer your team to be accomplishing? Explain.
5. Do you have sufficient access to resources such as data?
6. Do you have a sufficient support network of subject matter experts?
7. Do you receive adequate support from AFCAA?
8. Are you satisfied with the technical competencies of your cost analysis staff?
9. Currently, what kind of technical skill, experience, knowledge or other competencies would you say are generally lacking or not available among the cost analysts in your group?
10. What would get done that is not now done if your cost analysts had these competencies?
11. What would get done better if your cost analysts had these competencies?
12. Looking five years ahead, what kind of different technical skills, experience, knowledge, or competencies may be needed?
13. How often does your team change, either in actual personnel or activities?
14. How many cost analysts were hired specifically to work on your group's programs over the past 24 months?
15. How difficult is it to recruit cost analysts in your area?
16. Is there a difference in recruiting government civilians versus contractors?
17. How many cost analysts left your group in the past 24 months?
18. What is your understanding of why they left and where they went?
19. What measures would you suggest taking to improve the training and performance of cost analysts?
20. How do you think the newly developed APDP cost certification (BUS-CE) program is going to address some of the training deficiencies?
21. What steps have you taken to support recently implemented acquisition policies, specifically Weapon Systems Acquisition Reform Act (WSARA)?
22. Do you feel WSARA addresses the deficiencies of the acquisition community?

- a. If not, what deficiencies still need addressing?
23. Have any of the changes implemented to support WSARA been detrimental to your organization?
24. Have any of the changes implemented to support WSARA been beneficial to your organization?

Number employed of each		Civilian	Military	Contractor	FFRDC	Total
Within the last 6 months, what % Time spent on following activities:		% Time	% Time	% Time	% Time	% Time
a.	% time spent analyzing Earned Value Management (EVM) data (i.e. CPR, CSSR) using winsight or other program in support of program management					
b.	% time spent using Earned Value (EV) data in support of creating estimates					
c.	% time spent doing non-cost related financial management					
d.	% time spent managing support contractors					
e.	% time consulting with PM or personnel in other departments to discuss and formulate estimates or resolve issues					
f.	% time preparing initial estimates					
g.	% time reconciling estimates with either AFCAA or OSD					
h.	% time reviewing estimates					
i.	% time completing post estimate documentation					
j.	% time completing what-if drills for PM due to program changes or budget					
k.	% time spent in meetings					
l.	% time training (relating to cost only: included both time spent in training and time spent training others)					
m.	% time spent in non-cost related training (annual training – Information Protection, Human Trafficking, etc; do not include time spent doing cost related					
n.	% time Other _____					
<b>Total: Must add up to 100%</b>		<b>0%</b>	<b>0%</b>	<b>0%</b>	<b>0%</b>	

25. You indicated you spent \_\_% time completing what-if drills. Please elaborate on the reasons for these drills. Examples of reasons for what-if drills include identifying potential efficiencies or quantifying the impact of budget changes.

Read each statement and, using the scale below as reference, mark the number ranging from 1 “strongly disagree” to 5 “strongly agree” which indicates how you feel.

---

1 = Strongly Disagree      2 = Disagree      3 = Neither      4 = Agree      5 = Strongly Agree

---

Think about your current subordinates. The items below ask about your relationship with and thoughts about those particular individuals.

26. I am easily able to understand the message from my subordinates.
27. I am able to use rich and varied language when communicating with my subordinates.
28. My subordinates and I often have misunderstandings driven by the differences in our schedule.
29. My subordinates thoroughly understand my working environment.
30. My subordinates understand the daily requirements of my job.

31. My subordinates answer my questions on the same day I send the email.
32. My schedule changes based on my subordinates' schedule.
33. My subordinates work within close physical proximity to me.
34. I use email to communicate with my subordinates.
35. Without computers, I would be unable to accomplish my job.
36. I primarily complete my work through computers.
37. I have a good sense of the dynamics within my organization.
38. It is often difficult to get in touch with my subordinates.
39. Utilizing email makes it difficult to understand the tone of messages from my subordinates.
40. My subordinates' work schedules are in-sync with my own work schedule.
41. My subordinates and I have difficulties aligning our schedules.
42. I know what other people in my organization are doing.
43. My team members understand my job requirements.
44. I often speak in person with my coworkers to clarify messages received through electronic formats.
45. My subordinates respond to my messages (e.g. , phone, email) in a timely manner.
46. Time zones add difficulty to my work.
47. I primarily communicate with my team members through email.
48. I often speak in person with my subordinates to clarify messages received through electronic formats.
49. My subordinates and I always seem to be in tune as to what we are doing.
50. It is easy to exchange timely feedback with my subordinates.
51. My subordinates are available by cell phone throughout the workday.
52. I contact my subordinates through telephone conversations.
53. I am easily able to understand a variety of different cues (e.g.. emotional tone, feelings) from my subordinates.
54. I have a good understanding of the environment in which my organization operates.
55. I really understand why people behave the way they do in my organization.
56. I am easily able to maintain multiple conversations with subordinates.
57. My subordinates carry a cell phone.
58. My subordinates carry an email-enabled smartphone such as a Blackberry™.
59. I am easily able to tailor my messages to my subordinates.
60. My subordinates are available whenever I need them.
61. My subordinates and I have a common understanding of work requirements.
62. I utilize information technology in my daily interactions with my subordinates.

63. I am unable to communicate with my team/ subordinates without electronics: telephone, computer, etc.
64. I often interact with team members not co-located with me.
65. I often seek email clarifications from my subordinates regarding work requests.
66. It negatively affects my work when my subordinates are absent.

**To be completed Per Individual Supervised**

67. Name of subordinate:

**Leader Appraisal of the Member's Performance (Liden, Wayne & Stillwell, 1997)**

Read each statement and, using the scale below as reference, mark the number ranging from 1 "very ineffective" to 5 "very effective" which indicates how you feel.

---

1 = Very Ineffective      2 = Ineffective      3 = Neither      4 = Effective      5 = Very Effective

---

=====

=====

Think about your current subordinate. The items below ask about your relationship with, and thoughts about, this particular individual.

68. Rate the overall level of performance you observe for this subordinate.
69. What is your personal view of your subordinate in terms of overall effectiveness?
70. Overall, to what extent do you feel your subordinate effectively fulfills his or her role and responsibilities?

Read each statement and, using the scale below as reference, mark the number ranging from 1 "strongly disagree" to 5 "strongly agree" which indicates how you feel.

---

1 = Strongly Disagree      2 = Disagree      3 = Neither      4 = Agree      5 = Strongly Agree

---

Think about your current subordinate. The items below ask about your relationship with and thoughts about this particular individual.

71. This subordinate is superior to other subordinates I have supervised before.

**Trust (Mayer & Davis, 1999)**

72. My subordinate keeps my interests in mind when making decisions.
73. If my subordinate asked why a problem occurred, I would speak freely even if I were partly to blame.

- 74. It is important for me to have a good way to keep an eye on my subordinate.
- 75. Increasing my vulnerability to criticism by my subordinate would be a mistake.
- 76. If I had my way, I wouldn't let my subordinate have any influence over decisions that are important to me.

**Demographics**

- 77. AF Organization/ Office symbol:
- 78. ACAT Program(s) worked on during past 6 months:
- 79. Status: Full-time, Part-time
- 80. Current Mil Grade or Civilian Pay Plan-Series-Grade:
- 81. How far away in miles are you located from your supervisor?
- 82. Duty AFSC:
- 83. ADPD Certification type and level:
- 84. Financial certificates: CDFM, CDFM-A, CCEA
- 85. Duty title:
- 86. Full name:

## Appendix E. Questionnaire Pivot Tables

### Supervisor Report on Civilian Subordinates Time Usage

Row Labels	Sum of Number of Civilians Supervised	Average of Analyzing EVM Data	Average of Using Earned Value (EV) data	Average of Non-cost related FM	Average of Managing support contractors	Average of Consulting with PM	Average of Preparing initial estimates	Average of Reconciling estimates	Average of Reviewing estimates	Average of Post-estimate documentation	Average of What-if drills	Average of Meetings	Average of Cost related training	Average of Non-cost related training	Average of Other
edwards	11	0	0	5	0	13	5	0	15	5	0	10	10	3	35
eglin	11	11	11	18	0	5	2	10	8	5	5	10	10	5	0
hanscom	10	5	5	0	35	10	5	5	5	0	5	10	10	5	0
kirtland	6	9	4	8	6	13	15	0	8	8	5	10	13	4	0
los angeles	14	33	2	3	8	2	13	2	1	1	2	20	12	4	2
pentagon	7	0	0	0	5	20	20	5	5	5	10	15	14	1	0
robins	14	2	2	0	0	13	15	0	10	3	2	18	15	8	15
tinker	17	0	0	0	0	15	20	0	15	15	5	15	5	5	5
wpafb	14	3	3	5	5	15	15	6	10	8	23	5	2	3	0
<b>Grand Total</b>	<b>104</b>	<b>8</b>	<b>3</b>	<b>4</b>	<b>6</b>	<b>11</b>	<b>12</b>	<b>3</b>	<b>9</b>	<b>5</b>	<b>6</b>	<b>13</b>	<b>10</b>	<b>4</b>	<b>8</b>

### Supervisor Report on Military Subordinates Time Usage

Row Labels	Sum of Number of military Supervised	Average of Analyzing EVM Data	Average of Using Earned Value (EV) data	Average of Non-cost related FM	Average of Managing support contractors	Average of Consulting with PM	Average of Preparing initial estimates	Average of Reconciling estimates	Average of Reviewing estimates	Average of Post-estimate documentation	Average of What-if drills	Average of Meetings	Average of Cost related training	Average of Non-cost related training	Average of Other
edwards															
eglin															
hanscom	5	0	5	10	10	10	15	0	5	5	5	5	5	25	0
kirtland	1	0	0	25	0	10	10	0	10	20	0	15	5	5	0
los angeles	4	50	0	0	5	0	0	0	0	0	0	20	20	5	0
pentagon	3	0	5	9	0	15	20	5	0	5	5	20	15	1	0
robins															
tinker															
wpafb															
<b>Grand Total</b>	<b>13</b>	<b>13</b>	<b>3</b>	<b>11</b>	<b>4</b>	<b>9</b>	<b>11</b>	<b>1</b>	<b>4</b>	<b>8</b>	<b>3</b>	<b>15</b>	<b>11</b>	<b>9</b>	<b>0</b>



## Supervisor Report on Contractor Subordinates Time Usage

Row Labels	Sum of Number of KTR Supervised	Average of Analyzing EVM Data	Average of Using Earned Value (EV) data	Average of Non-cost related FM	Average of Managing support contractors	Average of Consulting with PM	Average of Preparing initial estimates	Average of Reconciling estimates	Average of Reviewing estimates	Average of Post-estimate documentation	Average of What-if drills	Average of Meetings	Average of Cost related training	Average of Non-cost related training	Average of Other
edwards															
eglin															
hanscom	30	5	5	10	5	0	45	5	0	5	10	10	0	0	0
kirtland	7	35	10	0	0	13	15	0	5	8	5	8	0	3	0
los angeles	15	20	10	0	0	10	23	10	5	5	0	10	5	2	0
pentagon	3	0	0	0	0	40	30	0	0	0	0	20	0	0	10
robins															
tinker															
wpafb	4	0	0	0	0	30	20	10	5	15	10	10	0	0	0
<b>Grand Total</b>	<b>59</b>	<b>16</b>	<b>6</b>	<b>2</b>	<b>1</b>	<b>18</b>	<b>25</b>	<b>4</b>	<b>3</b>	<b>7</b>	<b>5</b>	<b>11</b>	<b>1</b>	<b>1</b>	<b>2</b>

## Time Usage as Reported by Non-supervisor

Row Labels	Count of Mil/Civ	Average of Analyzing EVM Data	Average of Using Earned Value (EV) data	Average of Non-cost related FM	Average of Managing support contractors	Average of Consulting with PM	Average of Preparing initial estimates	Average of Reconciling estimates	Average of Reviewing estimates	Average of Post-estimate documentation	Average of What-if drills	Average of Meetings	Average of Cost related training	Average of Non-cost related training	Average of Other
edwards	2	0	0	25	0	3	10	0	25	8	0	10	10	10	0
eglin	4	4	4	3	0	14	15	5	15	6	8	15	9	4	0
gunter	1	0	0	6	45	20	0	0	20	0	0	5	2	2	0
hanscom	8	1	3	3	11	15	9	3	16	9	3	7	2	4	15
hill	6	3	1	2	0	13	33	2	8	15	4	9	6	4	0
kirtland	1	0	2	5	5	15	20	0	5	20	10	5	10	3	0
los angeles	12	14	5	7	6	6	5	7	7	3	6	17	7	7	5
osd	10	2	10	1	0	13	21	8	8	6	2	13	3	3	10
pentagon	23	3	3	4	2	11	21	10	14	5	5	11	5	3	3
robins	3	5	3	8	7	12	10	3	7	5	0	23	10	5	7
tinker	4	0	0	9	0	18	28	1	8	9	4	11	9	5	0
wpafb	35	1	2	9	1	15	18	5	11	5	5	11	8	5	4
<b>Grand Total</b>	<b>109</b>	<b>3</b>	<b>3</b>	<b>6</b>	<b>3</b>	<b>13</b>	<b>17</b>	<b>6</b>	<b>11</b>	<b>6</b>	<b>5</b>	<b>12</b>	<b>6</b>	<b>4</b>	<b>5</b>

## Variation between Supervisors and Organic Employees

	Analyzing EVM Data	Using EV data	Non-cost related FM	Managing support KTRs	Consulting with PM	Initial estimates	Reconciling estimates	Reviewing estimates	Post-estimate docs	What-if drills	Meetings	Cost related training	Non-cost training	Other
Edwards	-	-	20	-	10	5	-	10	3	-	-	-	7	35
Eglin	7	7	16	-	9	13	5	7	1	3	5	1	2	-
Hanscom	3	2	1	15	5	0	0	11	7	2	2	6	8	15
Kirtland	8	1	5	0	3	6	-	3	11	6	6	1	1	-
Los Angeles	22	4	5	1	5	5	5	6	3	4	3	7	3	4
AFCAA	3	1	1	2	7	1	5	11	0	3	6	9	2	3
Robins	3	1	8	7	1	6	3	3	3	2	5	6	3	9
Tinker	-	-	9	-	3	8	1	8	6	1	5	4	0	5
WPAFB	2	0	4	4	0	3	1	1	2	17	6	6	2	4

## References

- Allen, N. J., & Meyer, J. P. (1990). The measurement and antecedents of affective, continuance and normative commitment to the organization. *Journal of Occupation Psychology*, 1-18.
- Anderson, A. H., McEwan, R., Bal, J., & Carletta, J. (2007). Virtual team meetings: An analysis of communication and context. *Computers in Human Behavior*, 2558-2580.
- Arena, M. V., Leonard, R. S., Murray, S. E., & Younossi, O. (2006). *Historical Cost Growth of Completed Weapon System Programs*. Santa Monica, CA: RAND Corporation.
- Ballinger, G. A., Schoorman, F. D., & Lehman, D. W. (2009). Will you trust your new boss? The role of affective reactions to leadership succession. *The Leadership Quarterly*, 219-232.
- Baltes, B. B., Dickson, M. W., Sherman, M. P., Bauer, C. C., & LaGanke, J. S. (2002). Computer-mediated communication and group decision making: A meta-analysis. *Organizational Behavior and Human Decision Processes*, 156-179.
- Bauer, R., Koszegi, S. T., & Wolderstorfer, M. (2002). Measuring the degree of virtualization. An emperical analysis in two Austrian industries. *Vienna University of Economics and Business Administration*, 1-12.
- Bell, B. S., & Kozlowski, S. W. (2002). A typology of virtual teams: Implications for effective leadership. *Group Organization management*, 14-49.
- Bolten, J. G., Leonard, R. S., Arena, M. V., Younossi, O., & Sollinger, J. M. (2008). *Sources of Weapon System Cost Growth: Analysis of 35 Major Defense Acquisition Programs*. Santa Monica, CA: RAND Corporation.
- Borges, M. R., Pino, J. A., Fuller, D. A., & Salgado, A. C. (1999). Key issues in the design of an asynchronous system to support meeting preparation. *Decision Support Systems*, 269-287.
- Bourne, C. M. (1998). Unintended consequences of the Goldwater-Nichols act. *Joint Forces Quarterly*, 99-108.
- Carlson, J. R., & Zmud, R. W. (1999). Channel expansion theory and the experiential nature of media richness perceptions. *Academy of Management Journal*, 153-170.

- Chen, G., Bliese, P. D., & Mathieu, J. E. (2005). Conceptual framework and statistical procedures for delineating and testing multilevel of homology. *Organizational Research Methods*, 375-410.
- Child, J. T., & Shumate, M. (2007). The impact of communal knowledge repositories and people-based knowledge management on perceptions of team effectiveness. *Management Communication Quarterly*, 29-54.
- Christensen, D. S., Searle, D. A., & Vickery, C. (1999). The impact of the Packard commission's recommendations on reducing cost overruns on defense acquisition contracts. *Acquisition Review Quarterly*, 251-262.
- Chuboda, K. M., Lu, M., Watson-Manheim, M. B., & Wynn, E. (2003). How virtual are we? Measuring virtuality and understanding its impact in a global organization. *Proceeding of the International Conference on Information Systems*, 37.
- Cobanoglu, C., Warde, B., & Moreo, P. J. (2001). A comparison of mail, fax, and web-based survey methods. *International Journal of Marketing*, 405-410.
- Cohen, J. (1992). A power primer. *Psychological Bulletin*, 155-159.
- Cook, C., Heath, F., & Thompson, R. L. (2000). A meta-analysis of response rates in web- or internet-based surveys. *Educational and Psychological Measurement*, 821-836.
- Cooper, J., & Rumbaugh, R. (2009). Real acquisition reform. *Joint Force Quarterly*, 59-65.
- Cooper, M. A. (2002). *Department of Defense Implementation of Acquisition Reform Initiatives* (Masters Thesis). Monterey, CA: Naval Postgraduate School.
- Davis, J. M., Kettinger, W. J., & Kunev, D. G. (2009). When users are IT experts too: The effects of joint IT competence and partnership on satisfaction with enterprise-level systems implementation. *European Journal of Information Systems*, 26-37.
- Dirks, K. T., & Ferrin, D. L. (2002). Trust in leadership: Meta-analytic findings and implications for research and practice. *Journal of Applied Psychology*, 611-628.
- Drezner, J. A., Jarvaise, J. M., Hess, R. W., Hough, P. G., & Norton, D. (1993). *An Analysis of Weapon System Cost Growth*. Santa Monica, CA: RAND.

- Elshaw, J. J. (2010). *Trust in a Virtual Workplace: A Multi-Level Model Examining Implications of Virtualness and the Link to Performance and Commitment*. West Lafayette: Purdue University Press.
- Ersine, L. (2007). *How Far Does Leadership Travel? A Multidimensional Understanding of Relational Distance in Organizations*. University of Southern California Press.
- Fiol, C. M., & O'Connor, E. J. (2005). Identification in face-to-face, hybrid, and pure virtual teams: Untangling the contradictions. *Organization Science*, 19-32.
- Fox, C. H. (2010, February 18). CAPE and WSARA Implications for the Cost Community. Washington D.C.: OSD: Cost Assessment and Program Evaluation.
- Frank, D. F. (1997). A theoretical consideration of acquisition reform. *Acquisition Review Quarterly*, 279-294.
- Frazier, P. A., Tix, A. P., & Barron, K. E. (2004). Testing moderator and mediator effects in counseling psychology research. *Journal of Counseling Psychology*, 115-134.
- Gaddis, J. L. (2009). What is Grand Strategy? *American Grand Strategy After War* (p. 17). Duke University Press.
- Garnett, J. L., & Kouzmin, A. (2007). Communicating throughout Katrina: Competing and complementary conceptual lenses on crisis communication. *Public Administration Review*, 171-188.
- Gates, S. M., Keating, E. G., Jewell, A. D., Daugherty, L., Tysinger, B., Robbert, A. A., et al. (2008). *The Defense Acquisition Workforce: An Analysis of Personnel Trends Relevant to Policy, 1993-2006*. Santa Monica: RAND Corporation.
- Griffith, T. L., Sawyer, J. E., & Neale, M. A. (2003). Virtualness and knowledge in teams: Managing the love triangle of organizations, individuals, and information technology. *Management Information Systems Quarterly*, 265-287.
- Hakonen, M., Lipponen, J., Vartiainen, M., & Kokko, N. (2006). Trust, identity, and effectiveness in virtual organizations. *Journal of Management*, 60-65.
- Harman, B. A. (1995). From the Constitution to FASTA - Origins of acquisition reform. *Program Manager*, 12-17.
- Hartley, R. (2010, February 18). *Air Force Cost Analysis: What's Hot in 2010*. Retrieved from

- <http://209.48.244.135/DODCAS%20Archives/Forms/Presentation%20Topics.aspx?RootFolder=%2fDODCAS%20Archives%2f43rd%20DoDCAS%20%282010%29&FolderCTID=%7b07BD64D5%2d20CD%2d402D%2dB38C%2d300E3B7B604E%7d>
- Hartley, R. (2010, March 9). *Air Force Cost Workforce: Training and Education and Much More*. Retrieved from <http://209.48.244.135/DODCAS%20Archives/Forms/Presentation%20Topics.aspx?RootFolder=%2fDODCAS%20Archives%2f43rd%20DoDCAS%20%282010%29&FolderCTID=%7b07BD64D5%2d20CD%2d402D%2dB38C%2d300E3B7B604E%7d>
- Hartley, R. (2010, February 19). *Current Issues in Air Force Acquisition Financial Management*. Retrieved from <http://209.48.244.135/DODCAS%20Archives/Forms/Presentation%20Topics.aspx?RootFolder=%2fDODCAS%20Archives%2f43rd%20DoDCAS%20%282010%29&FolderCTID=%7b07BD64D5%2d20CD%2d402D%2dB38C%2d300E3B7B604E%7d>
- Hertel, G., Geister, S., & Konradt, U. (2005). Managing virtual teams: A review of current empirical research. *Human Resource Management Review*, 69-95.
- Hitt, M. A., Beamish, P. W., Jackson, S. E., & Mathieu, J. E. (2007). Building theoretical and empirical bridges across levels: Multilevel research in management. *Academy of Management Journal*, 1385-1399.
- Hofmann, D. A. (1997). An overview of the logic and rationale of hierarchical linear models. *Journal of Management*, 723-744.
- Hofmann, D. A., Morgeson, F. P., & Gerras, S. J. (2003). Climate as a moderator of the relationship between leader-member exchange and content specific citizenship: Safety climate as an exemplar. *Journal of Applied Psychology*, 170-178.
- Holbrook, M. A. (2003). *An Analysis of the Implementation of Acquisition Reform Initiatives and Contract Cost Variance* (Masters Thesis). Wright-Patterson Air Force Base, OH: Air Force Institute of Technology.
- Hough, P. G. (1992). *Pitfalls in Calculating Cost Growth from Selected Acquisition Reports*. Santa Monica, CA: RAND.
- Howell, J. M., & Hall-Merenda, K. E. (1999). The ties that bind: The impact of leader-member exchange, transformational and transactional leadership, and distance on predicting follower performance. *Journal of Applied Psychology*, 680-694.

- Huang, R., Kahai, S., & Jestice, R. (2010). The Contingent Effects of Leadership on Team Collaboration in Virtual Teams. *Computers in Human Behavior*, 1098-1110.
- Johnson, D. (2010, March 9). Role of Cost Assessment in the Post-WSARA Period; Policy, Impact on Programs. Retrieved from:  
<http://209.48.244.135/DODCAS%20Archives/Forms/Presentation%20Topics.aspx?RootFolder=%2fDODCAS%20Archives%2f43rd%20DoDCAS%20%282010%29&FolderCTID=%2f7b07BD64D5%2d20CD%2d402D%2dB38C%2d300E3B7B604E%7d>
- Johnson, D. (n.d.). Modernizing DOD's IT Acquisition Process. Retrieved from:  
<http://209.48.244.135/DODCAS%20Archives/Forms/Presentation%20Topics.aspx?RootFolder=%2fDODCAS%20Archives%2f43rd%20DoDCAS%20%282010%29&FolderCTID=%2f7b07BD64D5%2d20CD%2d402D%2dB38C%2d300E3B7B604E%7d>
- Kenny, D. A., Kashy, D. A., & Bolger, N. (1998). Data analysis in social psychology. (D. T. Gilbert, S. T. Fiske, & G. Lindzey, Eds.) *The handbook of psychology*, 1(4th), 233-265.
- Kirkman, B. L., & Mathieu, J. E. (2005). The dimensions and antecedents of team virtuality. *Journal of Management*, 700-718.
- Kirkman, B. L., Rosen, B., Tesluk, P. E., & Gibson, C. B. (2004). The impact of team empowerment on virtual team performance: The moderating role of face-To-face Interaction. *Academy of Management Journal*, 175-192.
- Klein, K. J., & Kozlowski, S. W. (2000). From micro to meso: Critical steps in conceptualizing and conducting multilevel research. *Organizational Research Methods*, 211-236.
- Kotzian, M. J. (2010). Acquisition leadership: An opportunity lost for acquisition excellence? *Defense Acquisition Review Journal*, 158-181.
- Lebas, M. J. (1995). Performance measurement and performance management. *International Journal of Production Economics*, 23-35.
- Liden, R. C., Wayne, S. J., & Stilwell, D. (1993). A longitudinal study on the early development of leader-member exchanges. *Journal of Applied Psychology*, 662-674.
- Lounsbury, D. W., Reynolds, T. C., Rapkin, B. D., Robson, M. E., & Ostroff, J. (2007). Protecting the privacy of third-party information: Recommendations for social and behavioral health researchers. *Social Science and Medicine*, 213-222.

- Lovelace, Jr., D. C. (1996). *Unification of the United States Armed Forces: Implementing the 1986 Department of Defense Reorganization Act*. August.
- Lush, M. (2009, October 22). Implementation of weapon systems acquisition Reform act (WSARA) of 2009.
- Marrone, J. A. (2010). Team boundary spanning: A multilevel review of past research and proposals for the future. *Journal of Management*, 911-940.
- Martins, L. L., Gilson, L. L., & Maynard, M. T. (2004). Virtual teams: what do we know and where do we go from here? *Journal of Management*, 805-835.
- Mayer, R. C., & Gavin, M. B. (2005). Trust in Management and Performance: Who Minds the Shop While the Employees Watch the Boss? *Academy of Management Journal*, 874-888.
- Meyer, J. P., & Allen, N. J. (1997). *Commitment in the Workplace: theory, research, and application*. Thousand Oaks, CA: SAGE Publications, Inc.
- Morgeson, F. P., & Hofmann, D. A. (1999). The Structure and Function of Collective Constructs: Implications for Multilevel Research and Theory Development. *Academy of Management Review*, 249-265.
- Needham, J. K. (2009, April 2009). DOD Can Improve Its Management and Oversight by Tracking Data on Contractor Personnel and Taking Additional Actions. *Acquisition Workforce*. Government Accountability Office.
- Niederman, F., & Beise, C. M. (1999). Defining the "virtualness" of groups, teams, and meetings. *Special Interest Group on Computer Personnel Research* (pp. 14-18). New Orleans: Association for Computing Machinery.
- Office of the Assistant Secretary of the Air Force (Acquisition). (2009). *Acquisition Improvement Plan*. Washington D.C.: U.S. Air Force.
- One Hundred Eleventh Congress. (2009, January 6). Weapon Systems Acquisition Reform Act of 2009. *Public Law 111-23*. Washington, DC.
- Pare, G., & Tremblay, M. (2004). The influence of high-involvement human resources practices, procedural justice, organizational commitment and citizenship behaviors on information technology professionals' turnover intentions. *Group Organization Management*, 326-357.
- Pegnato, J. A. (2003). Assessing federal procurement reform: Has the procurement pendulum stopped swinging. *Journal of Public Procurement*, 145-175.



- Phillips, R. A. (2008). *An Analysis of Aircraft Weapon Systems Cost Growth and Implementation of Acquisition Reform Initiatives Using A Hybrid Adjusted Cost Growth Model* (Masters Thesis). Wright Patterson AFB, OH: Air Force Institute of Technology.
- Podsakoff, P. M., MacKenzie, S. B., Lee, J.-Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology*, 879-903.
- Preston, D. S., & Karahanna, E. (2009). Antecedents of IS strategic alignment: A nomological network. *Information Systems Research*, 159-179.
- Radin, B. A. (1999). The government performance and results act and the tradition of federal management reform: Square pegs in round holes? *Journal of Public Administration, Research and Theory*, 111-135.
- Rank, J., Carsten, J. M., Unger, J. M., & Spector, P. E. (2007). Proactive customer service performance: Relationships with individual, task, and leadership variables. *Human Performance*, 363-390.
- Rast, W. R. (2010). A New Way to Start Acquisition Programs. *Defense AT&L*, 29-33. Retrieved from: [http://www.dau.mil/pubscats/ATL%20Docs/Jan-Feb/fast\\_jan-feb10.pdf](http://www.dau.mil/pubscats/ATL%20Docs/Jan-Feb/fast_jan-feb10.pdf)
- Reeves, S. V. (1996). *The Ghosts of Acquisition Reform: Past, Present and Future*. (Masters Thesis). Washington D.C.: National Defense University.
- Reig, R. W. (2000). Baselineing Acquisition Reform. *Acquisition Review Quarterly*, 33-46. Retrieved from: <http://www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA487528&Location=U2&doc=GetTRDoc.pdf>
- Robey, J. L., & Odell, C. W. (2009). *Facilitating Decision Making, Re-Use and Collaboration: A Knowledge Management Approach to Acquisition Program Self-Awareness*. (Masters Thesis). Monterey, CA: Naval Postgraduate School.
- Salas, E., Rosen, M. A., Burke, C. S., Nicholson, D., & Howse, W. R. (2007). Markers for enhancing team cognition in complex environments: The power of team performance diagnosis. *Aviation, Space, and Environmental Medicine*, B77-B85.
- Schleyer, T. K., & Forrest, J. L. (2000). Methods for the design and administration of web-based surveys. *Journal of the American Medical Informatics Association*, 416-425.

- Schoorman, F. D., Mayer, R. C., & Davis, J. H. (2007). An integrative model of organizational trust: Past, present, and future. *Academy of Management Review*, 344-354.
- Shao, Y. P., Lee, M. K., & Liao, S. Y. (2000). Virtual Organizations: The Key Dimensions. *Research Challenges, 2000* (pp. 3-8). Buffalo, NY: Conference on Academia/Industry Working.
- Shekhar, S. (2006). Understanding the virtuality of virtual organizations. *Leadership and Organization Development Journal*, 465-483.
- Smircich, L., & Chesser, R. (1981). Superiors' and subordinates' perception of performance: Beyond disagreement. *Academy of Management Journal*, 198-205.
- Smirnoff, J. P. (2006). *The Impact of Economic Factors and Acquisition Reforms on the Cost of Defense Weapon Systems* (Masters Thesis). Dayton, OH: Air Force Institute of Technology.
- Solomon, D. J. (2001). Conducting Web-Based Surveys. *Practical Assessment Research and Evaluation*, 4. Retrieved from: [http://cogprints.org/2357/1/Web\\_Survey\\_Article.pdf](http://cogprints.org/2357/1/Web_Survey_Article.pdf)
- Sparrowe, R. T., & Liden, R. C. (1997). Process and structure in leader-member exchange. *The Academy of Management Review*, 522-552. Retrieved from: <http://www.soc.ucsb.edu/faculty/friedkin/Syllabi/Soc147/Process%20and%20Structure%20in%20Leader%20Member%20Exchange.pdf>
- Sullivan, M. J. (2009, March 18). DOD Must Prioritize Its Weapon System Acquisitions and Balance Them with Available Resources. *Defense Acquisitions*. Washington D.C.: Government Accountability Office.
- Under Secretary of Defense. (2009, December 04). Implementation of the Weapon Systems Acquisition Reform Act of 2009. *Directive-Type Memorandum (DTM) 09-027*. Washington, DC: Department of Defense.
- United States Coast Guard. (2008). *Blueprint for Acquisition Reform, Version 3.0*. Washington D.C.: U.S. Department of Homeland Security.
- Vernez, G., & Massey, H. G. (2009). *The Acquisition Cost-Estimating Workforce*. Santa Monica, CA: RAND Corporation.
- Wang, D.-W., Liao, C.-J., & Hsu, T.-s. (2006). An epistemic framework for privacy protection in database linking. *Data and Knowledge Engineering*, 176-205.

- Wang, I.-M., Shieh, C.-J., & Wang, F.-J. (2008). Effect of human capital investment on organizational performance. *Social Behavior and Personality*, 1011-1022.
- Warkentin, M. E., Sayeed, L., & Hightower, R. (1997). Virtual teams versus face-to-face teams: An exploratory study of a web-based congerence system. *Decision Sciences*, 975-996.
- Wayne, S. J., Shore, L. M., & Linden, R. C. (1997). Perceived organizational support and leader-member exchange: A social exchange perspective. *Academy of Management Journal*, 82-111.
- Weiss, H. M., Nicholas, J. P., & Daus, C. S. (1999). An examination of the joint effects of affective experiences and job beliefs on job satisfaction and variations in affective experiences over time . *Organziational Behavior and Human Decision Processes*, 1-24.
- Younossi, O., Arena, M. V., Leonard, R. S., Roll, Jr., C. R., Jain, A., & Sollinger, J. M. (2007). *Is Weapon System Cost Growth Increasing? A Qualitative Assessment of Completed and Ongoing Programs*. Santa Monica: RAND Corporation.
- Younossi, O., Lorell, M. A., Brancato, K., Cook, C. R., Eisman, M., Fox, B., et al. (2008). *Improving the Cost Estimation of Space Systems: Past Lessons and Future Recommendations*. Santa Monica, CA: RAND Corporation.

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Captain Whitar S. Darvill graduated from Metcalfe County High School in Edmonton, Kentucky. He entered undergraduate studies at the University of Central Florida in Orlando, Florida, where he graduated with a Bachelor of Science degree in Business Administration and a major in finance in December, 2003. He was commissioned through the Officer Training School at the Maxwell Air Force Base, Alabama on April 1, 2006.

His first assignment was at Edwards AFB, California, as resource advisor for the 412th Test Wing, Special Project directorate. In April, 2008, he was assigned to the 95th Comptroller Squadron at Edwards AFB, where he served as financial services officer. While stationed at Edwards, he received a Master in Business Administration from Webster University, Saint Louis Missouri, in May, 2007. In August, 2009, he entered the Graduate School of Engineering and Management, Air Force Institute of Technology. Upon graduation, he will be assigned to the Air Force Cost Analysis Center at Washington, D.C.

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14. ABSTRACT Many researchers have sought to identify the sources for cost and schedule growth, most researchers failed to analyze the resource utilization of the cost community. This research explores how the cost community allocates its time. Furthermore, by examining how resources are spent, this research will juxtapose the desires of recent Congressional and Department of Defense policies against the current demands of the cost community. A thorough understanding of resource allocation requires research into the inherent virtualness of the community. Early virtualness predicated the notion of extremes, either virtual or not. However, recent literature expands virtualness into gradients and explains that all teams display some measure of virtualness. Unfortunately, scholars currently debate the basic definition of virtualness either being comprised of three or four individual dimensions. This research uses an internet-based questionnaire to ascertain a measure of virtualness. The findings of this research support a four dimension measure of virtualness. This research uses structural equation modeling to validate and test for good reliability of the created 13 item measure for virtualness. This research finds that resources are largely allocated to the creation and modification of cost estimates, while few resources are spent on the implementation or follow-up of estimates.					
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